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Given to the
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40TH CONGRESS, 2d Session. } HOUSE OF REPRESENTATIVES. { Ex. Doc. No. 1.

MESSAGE

OF THE

PRESIDENT OF THE UNITED STATES

AND

ACCOMPANYING DOCUMENTS,

TO THE

TWO HOUSES OF CONGRESS

AT THE

COMMENCEMENT OF THE SECOND SESSION OF THE FORTIETH CONGRESS.

BOSTON ATHENÆUM
CA
1958

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1867.

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REPORT

OF

THE SECRETARY OF WAR.

PART II.

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REPORT

OF

THE CHIEF OF ENGINEERS.

HEADQUARTERS CORPS OF ENGINEERS,
Washington, October 21, 1867.

GENERAL: I have the honor to present the following report of the operations of the corps of engineers for the fiscal year ending June 30, 1867:

The number of officers in the corps of engineers at the end of the year was one hundred and seven on the active list and five on the retired. During the year eleven were added to the corps by promotion of graduates of the Military Academy. There have been retired from active service, four; resigned, one; one was promoted out of the corps, and one died.

On the 30th of June, 1867, the officers were distributed as follows:

On duty at the headquarters of the corps	5
On duty with board of engineers for fortifications	5
On duty with engineer battalion	13
On duty on construction of defences and on river and harbor improvements	39
On duty on river and harbor improvements	12
On duty on survey of the lakes	5
On special duty	3
On detached duty	17
Absent with leave	1
Retired off duty	1
Graduates Military Academy	11
	112

The officers detached were on duty as follows:

Members of the Light-house Board, Brigadier General Richard Delafield, brevet major general United States army, and Colonel Hartman Bache, brevet brigadier general United States army	2
Engineer secretary to Light-house Board, Major O. M. Poe, brevet brigadier general United States army	1
United States commissioner for Pacific railway, Colonel James H. Simpson, brevet brigadier general United States army	1
Aides-de-camp of the General of the army, Major C. B. Comstock, brevet brigadier general United States army, and Major O. E. Babcock, brevet brigadier general United States army	2
Chief astronomer and surveyor, northwest boundary commission, Major J. G. Parke, brevet major general United States army	1
On staff of Lieutenant General, commanding military division of the Missouri, Major W. E. Merrill, brevet colonel United States army	1
On staff of major general commanding department of the Gulf, Captain G. L. Gillespie, brevet lieutenant colonel United States army	1
On staff of brevet major general commanding department of Dakota, Captain W. J. Twining, brevet major United States army	1

On staff of major general commanding department of the Missouri, Lieutenant M. R. Brown	1
On staff of brevet major general commanding department of the Platte, Lieutenant R. W. Petrikin	1
On duty at Military Academy, Major H. M. Robert; Captain P. S. Michie, brevet lieutenant colonel United States army; Captain W. H. H. Benyaurd, brevet major United States army, and Lieutenant M. B. Adams	4
Member of special commission to reimburse the State of Ohio for aid in suppressing rebellion, Lieutenant Colonel Lorenzo Sitgreaves	1
	17

SEA-COAST AND LAKE FRONTIER DEFENCES.

Such progress as was consistent with the state of the important questions now in course of investigation respecting the increased power of artillery, and the best method of covering scarps, guns, and men from its action, and as was practicable with the reduced appropriations made by Congress for the service, has been made, during the year, upon the several maritime defensive works now in process of construction, repair, or melioration. The efforts of the year have been directed for the most part to the advancement of those portions of the works, the character of which is least affected by these questions; such as piers, quarters, store-rooms, earthworks, platforms, and magazines.

Restoration of forts injured during the war has been continued, repairs of damages caused by the elements effected, and such precautionary works executed as future security required.

A board of engineers for fortifications, consisting of the following officers: Colonel J. G. Barnard, brevet major general United States army; Colonel George W. Cullum, brevet major general United States army; Lieutenant Colonel Z. B. Tower, brevet major general United States army; Lieutenant Colonel H. G. Wright, brevet major general United States army, and Major C. B. Reese, brevet brigadier general United States army, secretary, has been constituted, to which is intrusted the duty of making examinations, inquiries, and experiments requisite to determine the force of the largest artillery, the means of using it in the forts, and of protecting our structures, guns, and gunners against its power. As soon as the deliberations of this board are completed and its conclusions matured and verified, the labors of construction should be greatly enlarged. This will require (especially in view of the great appreciation of cost of materials and workmanship) corresponding appropriations of money to enable work to be actively resumed on the defences, and the application of materials of increased cost to be made upon them.

In several cases it will be necessary, also, to apply to Congress for grants for the commencement of new works, which are required to keep an enemy at a greater distance from important points than has heretofore been the case.

Some special boards of officers have been constituted during the year, particularly one for the Pacific coast, presided over by Lieutenant Colonel B. S. Alexander, brevet brigadier general United States army, and composed of the senior constructing officers on that coast, the distance and importance of which have required this to be done.

The estimates presented for the service of the fiscal year ending June 30, 1869, provide only for the continuation, at moderate rates, of such parts of works in progress as are not likely to be affected by the questions above indicated. The solution of these questions will require special calls from this office for further appropriations, for the purpose of pressing forward other parts of these works, and for the commencement of new defences for important and exposed positions, maritime cities, naval establishments, &c.

FORTIFICATIONS.

Fort Wayne, Detroit, Michigan, in charge of Colonel T. J. Cram, brevet major general United States army.—The breast-height wall has been completed in the main work, with the exception of a space of twenty-five feet on the north face of east bastion. In the demilune it has been nearly finished. The doors of the casemates and magazines have been made, hung, and completed, except their fastenings. The road leading from the engineer dock to main entrance, and thence to the limit of government grounds at the county road, has been finished. A covered drain has been constructed in the ditch from the road to the main sewer. Another drain is in course of construction in the ditch, extending around the north bastion to the drain first referred to. The ramps, from the parade to the terreplein, have been paved. The gun platforms of the main work have been completed. In the demilune the platforms are now generally ready for their irons. The sodding and embanking for the parapet and banquettes have been nearly finished. The new demilune magazine is well on towards completion. Operations in contemplation for the fiscal year ending June 30, 1868: To complete the demilune magazine; the platform for 15-inch gun in its salient with its breast-height and parapet thereabout; to widen the ditch of the main work; to begin the new lateral batteries; to complete the drains in the ditch; to insert the pintles and set the traverse irons of the gun platforms; to place the fastenings upon all doors belonging to casemates and magazines; to construct two additional gates for sallyports; to complete drains, gate to entrance from county road, and prepare ground for raising sod for counterscarp.

Appropriation asked for the next fiscal year, $50,000.

Fort Porter, Black Rock, near Buffalo, New York, in charge of Major John A. Tardy and Colonel T. J. Cram, brevet major general United States army.—Operations at this work during the year were confined to the repair of two small temporary buildings for store-rooms.

No appropriation asked for the next fiscal year.

Additional works for the defence of Buffalo, New York.—Operations here are awaiting the result of experiments and the deliberations of the board of engineers upon the application of new materials to purposes of defence.

No appropriation asked for the next fiscal year.

Fort Niagara, mouth of Niagara river, New York, in charge of Major John A. Tardy and Colonel T. J. Cram, brevet major general United States army.—But little has been done at this work during the year—operations having been suspended in October, 1866. Labor, up to that period, was applied mainly in excavating earth, removing old timber of scarp and sallyport, making and laying concrete, building dry wall, constructing casements of southeast flank, and digging wells in rear of scarp.

It is proposed, during the present year, to complete the coping of the new scarp on the land front, to put in the filling back of the new scarp, and sod after completing the parapet, and to complete the new sallyport, which was left in an unfinished condition.

Appropriation asked for the next fiscal year, $50,000.

Fort Ontario, Oswego, New York, in charge of Lieutenant Colonel C. E. Blunt, brevet colonel United States army.—The principal operation of the year has been the raising of the scarp wall of the land or entrance front to its final height along the curtain, flanks, and one-half of each face. The masonry of the gateway, postern arch, and casemates of left flank, including embrasures, has been completed. Part of the scarp of right face of bastion E has also been raised three feet on an average, to reference (13′). The stone used is quarried and cut on the public land. During the year ending June 30, 1868, it is proposed to complete the scarp wall, and to continue the construction of the flanking arrangements. This work is now in such a condition that it is very desirable that the construction should progress continuously to completion.

Appropriation asked for the next fiscal year, $60,000.

Fort Montgomery, outlet of Lake Champlain, New York, in charge of Major C. B. Reese, brevet brigadier general United States army, and Lieutenant Colonel C. E. Blunt, brevet colonel United States army.—At this work the principal operations have been the following: Completion of seventeen barbette gun platforms; laying coping of parapet wall on curtains one, two, and four, and bastions A and B, (thus completing the scarp wall of the fort;) raising staircase of bastion C from foundation to level of gun casemates, (23.58′;) laying flagging in lower story of bastion C, and concrete foundation for lower floor of bastion E; turning communication arches in lower story of bastion C; advancing interior finish of officers' quarters; embanking and laying stone facing on coverface; driving piles on south end of wet ditch with a view to a modification of the counterscarp. During the present year it is proposed to complete the staircase in bastion C, the parade wall of curtain three, and the barbette magazines on the land front, and to continue the interior finish of the officers' quarters, &c. The fort is now ready for a considerable portion of its armament.

Appropriation asked for the next fiscal year, $60,000.

Fort Knox, narrows of Penobscot river, Maine, in charge of Major Godfrey Weitzel, brevet major general United States army, and Major Thomas Lincoln Casey, brevet colonel United States army.—During the past year the north covered way, northeast demi-bastion, and defensive gallery, together with the closure wall and single caponniere of the north ditch, have been completed. The south and west glacis were brought to grade for a distance of some forty feet from their crests. Some progress was made with store-rooms in the parade of the main work, and a large amount of the finish of the quarters in the west front put in; two 15-inch platforms were completed in batteries A and B, and seven platforms for front pintle guns in the north covered way. During the present year it is proposed to complete the store-rooms of the parade, except their mastic coverings, the banquettes of the north counterscarp gallery, the magazine of the northeast demi-bastion, and nine positions for guns requiring only their traverse irons; the postern doors of the main and out-works will also be hung.

Appropriation asked for the next fiscal year, $50,000.

Fort Popham, Kennebec river, Maine, in charge of Major Godfrey Weitzel, brevet major general United States army, and Major Thomas Lincoln Casey, brevet colonel United States army.—During the past year the scarps of the gun fronts and bastions have been brought practically to the level of the cordon line; the second tier of casemate arches all along these fronts has been completed, with its accompanying parade wall, piers, and stairway towers, and the flooring of the second tier of casemates completed far enough to receive the traverse irons of the second tier of gun platforms. During the remainder of the present working season the roof surfaces will be covered with asphaltum over eleven arches of the gun fronts; the foundation of three of the magazine traverses of the barbette will be laid, and the remainder of the work covered with boards to protect it during the coming winter.

Appropriation asked for the next fiscal year, $75,000.

Fort Gorges, on Hog Island ledge, Portland, Maine, in charge of Lieutenant Colonel George Thom, brevet brigadier general United States army.—The operations on this fort during the past year have been applied to completing the roof surfaces of the gorge, and filling the same with earth up to the level of the terreplein, in reference (47′); towards lining and finishing the quarters, which are partially floored, furred, and lathed, and have had all the window frames put in, and nearly all the sashes made, glazed, and fitted; to building four privy vaults and cutting outlets for same through the gorge scarp, and completing the modifications of the drainage; to re-enforcing with granite arches the scarp walls of the gorge magazines, and lining the same; to building the stairway towers in the angles of fronts one, two, four, and five, the foundations of which have been laid, and the superstructure of one of them one-third laid; and to building foundation for bomb-proof traverse on front five; to the preparation of cut stone for the stairway towers, bomb-proof traverses, centre pintle-gun platforms, re-enforcing magazines and other parts of the work. The gun casemates and embrasures have been all completed, in all their details, and are ready for their armament.

Appropriation asked for the next fiscal year, $25,000.

New Fort Preble, Portland harbor, Maine, in charge of Lieutenant Colonel B. S. Alexander, brevet brigadier general United States army, Lieutenant Colonel George Thom, brevet brigadier general United States army, and Major Thomas Lincoln Casey, brevet colonel United States army.—During the past year all the grillage and capping for the foundations of the scarps was completed, and the foundations of all the scarps, excepting the north flank, brought to about reference (12′). Sufficient work was also done upon the superstructure of the scarps to complete eight more embrasures, and to bring to the level of the soles eight other embrasures. The rock excavation for the scarps of the old work was about one-half completed, and the masonry of fronts B and C commenced. During the present year it is proposed to complete all the additions to, and modifications of, the older portions of this fortification.

Appropriation asked for the next fiscal year, $25,000.

Fort Scammell, Portland harbor, Maine, in charge of Lieutenant Colonel B. S. Alexander, brevet brigadier general United States army, and Major Thomas Lincoln Casey, brevet colonel United States army.—During the past year five embrasures were built in the scarps of the second tier of the west bastion, while in the east bastion four casemates for guns and one for flank howitzers were completed, and the two magazines in the gorge of this work nearly finished. During the coming year it is proposed to complete the four magazines in the gorges of the east and west bastions, and the magazine traverses A, B, and C in the main work.

Appropriation asked for the next fiscal year, $60,000.

Fort Constitution, Portsmouth harbor, N. H., in charge of Lieutenant Colonel Z. B. Tower, brevet major general United States army, and Lieutenant Colonel J. G. Foster, brevet major general United States army.—The work performed during the year comprised the laying of one course of the scarp wall of the north front, the building of the scarp of the northeast front to the reference of (15′), the construction of two embrasures and commencement and almost completion of two others on that front, the laying of the flagging between four main piers upon the southeast front, and the construction of two embrasures on the south front.

No appropriation asked for the next fiscal year.

Fort McClary, Portsmouth harbor, Kittery Point, Me., in charge of Lieutenant Colonel Z. B. Tower, brevet major general United States army, and Lieutenant Colonel J. G. Foster, brevet major general United States army.—The work executed comprises the excavation for ditch, by blasting out the rock on the north and west fronts, which has been nearly completed; the preparations for laying the first courses of the scarp wall upon those fronts; the taking down of a portion of the scarp of the southwest front, and the commencement of its reconstruction.

It is proposed during the present year to complete the rock excavation of the ditch on the north and west fronts, to build the entire scarp wall of those fronts, including the two flanking caponnieres, with their entrances and the adjacent magazines, to complete the alteration of the west end of the scarp on the south front, and to continue this wall to form the revetment of the foot of the ditch of the west front.

Appropriation asked for the next fiscal year, $100,000.

Fort Warren, Boston harbor, Mass., in charge of Colonel H. W. Benham, brevet major general United States army.—The small amount of funds available was expended in completing fittings of casemates and relaying the traverse circles with longer radii on the parapet front number one. The fittings of the officers' quarters were arranged and a hospital completely prepared, the cutting of the main gateway stones executed, the ravelin magazine was embanked and sodded, and other parts of the slopes and embankments repaired and sodded.

It is expected that with the funds available for this year the main gateway will be completed; the two traverse magazines of the coverface, and the main one upon the ravelin, and one or two on the front number five, in rear of the ravelin, will be completed.

Appropriation asked for the next fiscal year, $90,000.

Fort Winthrop and batteries, Boston harbor, Mass., in charge of Colonel H. W. Benham, brevet major general United States army.—During the year the earth covering and sodding of the west magazine of south battery was completed, the covering and sodding of the other magazines; and the parapet of the south battery was repaired and grassed, as well as those of the east and northwest batteries; the broken ground of the bluff below the south battery was regulated and dressed with mould and grass seed. The northeast and northwest bastions of the earth-work to surround the tower were commenced, the tunnel covered way to south battery was excavated, the concreted foundation of its walls laid and those walls commenced.

It is expected that the arched covered way to connect the ditch of the tower with the south battery will be completed and covered over this autumn, and that a great portion of the earthen embankment of the glacis at the tower, with part of its parapets, will, also, be in position in season to secure the consolidating action of the winter season upon it. On the opening of the next season this earth-work will be carried toward completion as far as the funds available will permit.

Appropriation asked for the next fiscal year, $100,000.

Fort Independence, Boston harbor, Mass., in charge of Colonel H. W. Benham, brevet major general United States army.—No work was executed during the fiscal year for want of funds, but it is expected that the work of building the traverse magazines, and those in the northwest and southwest exterior batteries, with the modifications proposed for the parapet of the latter, with the double traverse magazine on the northeast bastion B will be completed during the present fiscal year. A sea wall, to connect with the present one in rear of the southeast exterior battery, is necessary to protect the shore at that point.

Appropriation asked for the next fiscal year, $50,000.

Permanent forts at Provincetown harbor, Mass.—Commencement of operations here are waiting for the preparation of plans for the works.

No appropriation asked for the next fiscal year.

Fort at Clark's Point, New Bedford harbor, Mass., in charge of Major George H. Mendell, brevet colonel United States army, and Captain Jared A. Smith, brevet major United States army.—Three casemates have been made ready for guns, three casemates for quarters made ready for interior finish. Masonry of five magazines completed and three magazines made ready for powder. The scarp and parade walls, including stair towers, chimneys and flues, nearly completed. The arrangements for guns in barbette are far advanced. It is proposed during the present fiscal year to complete as nearly as possible the arrangements for guns "en barbette," and it is expected that not less than three front pintle platforms, and two with centre pintles, will be ready for guns, and that the foundations for all the barbette guns will be ready to receive the platforms, and all the stone will be cut. The scarp and parade walls will be completed, and the breast height wall, parapet and terreplein well advanced. All the brick furring of quarters will be completed, and it is expected considerable progress will be made in construction of ditch and counter-scarp.

Appropriation asked for the next fiscal year, $50,000.

Fort Adams, Newport harbor, R. I., in charge of Major D. C. Houston, brevet colonel United States army.—The work at this fort, on the main work, has consisted in relaying the traverse circles in the casemates of the west front and repairs of the officers' quarters, substituting cast iron hoppers for the open sinks in the southeast bastion for the use of the soldiers, repairs of brick terreplein, repairs of parapet, and various other repairs essential to the preservation of the work. The alteration of the coverface has been completed. Four additional platforms have been laid, two for fifteen-inch guns and two for ten-inch guns; also, two service magazines have been constructed. Work on the exterior batteries, to adapt them to an armament of fifteen-inch and heavy rifled guns, was commenced in September last. The work proposed for the year ending June 30, 1868, so far as can be foreseen at present, will consist in the prosecution of the work on the exterior batteries, repairs of permanent wharf, building a guard-house, repairs of brick embrasures of the fort, alterations of present magazines and construction of service magazines, covering the arches of the main work west front to prevent leakage, &c.

No appropriation asked for the next fiscal year.

Defences on Dutch island, western entrance, Narragansett bay, R. I., in charge of Major D. C. Houston, brevet colonel United States army.—The work at this point during the year, which was not commenced until the latter part of March, 1867, has consisted mainly in altering an earthen battery built during the war, and known as the "upper battery," to adapt it to receive an armament of heavy guns, centre pintle carriages. Since that time the old platforms have been removed, the embrasures filled up, and six pintle blocks set; concrete laid for the foundations of the gun platforms and magazines. In addition, repairs have been made to the various buildings and wharf necessary to their preservation, and roads constructed and repaired. The operations for the year ending June 30, 1868, will, it is expected, consist in completing the alterations of the "upper battery," building a permanent wharf, moving and altering buildings for office and overseer's quarters, making roads and preparing site for work on the summit of the island, and prosecuting the work under the plans already prepared. The "lower battery" has been provided with two service magazines.

No appropriation asked for the next fiscal year.

Fort Trumbull, New London harbor, Conn., in charge of Captain Samuel M. Mansfield, brevet lieutenant colonel United States army, and Major D. C. Houston, brevet colonel United States army.—The work at this fort during the year has consisted only in a few repairs necessary to its preservation in good order.

No appropriation asked for the next fiscal year.

Fort Hale, New Haven harbor, Conn., in charge of Captain Samuel M. Mansfield, brevet lieutenant colonel United States army, and Major D. C. Houston, brevet colonel United States Army.—In February of this year the work was completed, the public property, tools, &c., sold at auction, and the fort placed in charge of a fort keeper. The magazines of this work are in good condition.

No appropriation asked for the next fiscal year.

Fort Schuyler, eastern entrance to New York harbor, in charge of Major H. L. Abbot, brevet brigadier general United States army.—The operations during the past year have been confined to completing two service magazines, beginning and partly constructing two other service magazines, preparing to lay two fifteen-inch gun platforms, with necessary removal of old platforms, a stone parapet and breast height wall, all upon the coverface, and to making necessary repairs upon the main work and engineer buildings. The operations proposed for the fiscal year ending 30th June, 1868, are the following: completing two magazines and two fifteen-inch gun platforms, &c., and repairs to wharf, which may be done with the balance now available; constructing magazine in place of arms, and extending sea wall.

Appropriation asked for the next fiscal year, $45,000.

Fort at Willett's Point, eastern entrance to New York harbor, in charge of Lieutenant Colonel James C. Duane, brevet brigadier general United States army.—Scarp walls have been built to within two courses of their tull height; piers have been built to spring lines of casemate arches, second tier; filling room in channel bastion finished; magazine in channel bastion nearly finished; casemate floors, second tier, finished, excepting four; northwest drain gallery finished; northeast drain gallery commenced; new guard house nearly finished.

Appropriation asked for the next fiscal year, $100,000.

Fort Columbus, Governor's island, New York harbor, in charge of Major Nicolas Bowen, brevet colonel United States army.—The operations of the year at this work consisted, in part, in flagging the walks and curbs of the parade, and the area of the magazine, removing old cobble stone covering of postern and ramps and replacing it with the Belgian pavement, cleaning and pointing, where necessary, the masonry of the main gateway, postern, breast heights, magazines and sortie passages, cleaning and renewing drains and gutters, grading and repairing roads and walks on the island and improving their drainage, repairing drawbridge, and constructing a vault cellar, grassing bare spots on glacis and other slopes, renewing fences and removing hot-shot furnaces.

It is proposed during the present fiscal year to alter the slope of the cunettes and renovate the system of drainage for the work, to continue unfinished repairs, point the scarp walls and other masonry, repair the coping and top of main gateway, and effect such other repairs as may be necessary.

No appropriation asked for the next fiscal year.

Castle Williams, Governor's island, New York harbor, in charge of Major Nicolas Bowen, brevet colonel United States army.—The tower steps have been finished, the roof of one tower has been entirely renewed and the other repaired and painted. All the masonry has been pointed. The three galleries of communication of the casemates and the one along the gorge wall have been almost entirely renewed, painted, and braced with iron. The doors of the magazine, and the gates, the window sashes, leaders and gutters, have been repaired and painted, the mastic covering of the barbette tier has been repaired and the leakage through it stopped. The shot furnace removed.

The present fiscal year it is proposed to make such repairs as may be required for the preservation of the work.

No appropriation asked for the next fiscal year.

South Battery, Governor's island, New York harbor, in charge of Major Nicolas Bowen, brevet colonel United States army.—Slight repairs have been made to the scarp walls. Such other repairs as may be required for the preservation of the work will be made this year.

No appropriation asked for the next fiscal year.

Fort Wood, Bedloe's island, New York harbor, in charge of Major Nicolas Bowen, brevet colonel United States army.—During the year the drains have been cleaned and repaired. The appearance of cholera, and a resulting quarantine of the island, interrupted further work. For the operations of the present year it is proposed to point the masonry, paint the two magazines, improve the system of drainage, repair the drawbridge and gates, sow grass seed where required, repave parade and posterns, and make such other repairs as a proper preservation of the work may call for.

No appropriation asked for the next fiscal year.

New Battery, near Fort Hamilton, New York harbor, in charge of Lieutenant Colonel John Newton, brevet major general United States army.—Operations during the year.—Construction of the south magazine, taking up platforms to make room for traverse magazines, and commencing the same. At seven platforms, revetment and platform flags have been set, and portions of breast-height wall not heretofore finished have been laid. At platform No. 22 the traverse stones have been rebedded and lowered one foot; five magazine doors made; embanking parapet of battery, sodding, grading and soiling slopes of parapet.

Present condition of work.—North magazine ready for service; south magazine arches turned and mastic covering applied, not entirely complete; three traverse magazines complete, one in process of being lengthened; five traverse magazines commenced and in process of construction. The battery is essentially ready for service.

No appropriation asked for the next fiscal year.

Fort Hamilton, New York harbor, in charge of Lieutenant Colonel John Newton, brevet major general United States army.—Operations during the past year.—A trifling amount has been expended in cutting down some embrasures of the north front, to allow egress from the casemates, and in removing shot furnaces of the old pattern from the interior of the work.

Condition of the work.—The work needs occasional and slight repairs in pointing, &c.

No appropriation asked for the next fiscal year.

Fort Wadsworth, New York harbor, in charge of Colonel J. G. Barnard, brevet major general United States army, and Major Q. A. Gillmore, brevet major general United States army.—On the interior of this work the guardhouse and the two cisterns adjacent thereto have been finished, and some necessary pointing of masonry done. On the exterior the sand and earth, which has for years been accumulating in the ditch from the washings of the slopes and other unfinished earthwork near the fort, has been excavated to within a few inches of the proper depth, and two sluice-ways from the ditch to tide-water completed.

No appropriation asked for the next fiscal year.

Fort on site of Fort Tompkins, New York harbor, in charge of Colonel J. G. Barnard, brevet major general United States army, and Major Q. A. Gillmore, brevet major general United States army.—During the year five additional casemates (second tier) have been furred, twenty-one casemates (eleven first tier and ten second tier) floored, and nine casemates (six in the south flank and three in the southwest face) fitted up for soldiers' quarters. All the doorway openings in the fort have been provided with suitable wrought-iron doors, so that very little except glazing remains to be done to render all the casemates in the four land fronts ready for occupancy. On the exterior the road leading down to North Cliff battery has been cut and formed, and the slopes on either side brought into shape and partially finished. Extensive damages by rain-storms to the main slopes on the channel front have likewise been repaired, a twelve-inch drain from south soldiers' latrine to foot of slope put in place, and the battery southeast of Fort Tompkins finished and put in readiness for its guns. The platforms for the guns on the four land fronts are finished. The operations of the current fiscal year will be limited to work upon the latrines on the slope in front of the work, to a moderate extent, and providing for the overflow of the cisterns within the work.

Appropriation asked for the next fiscal year, $25,000.

Battery Hudson, New York harbor, in charge of Colonel J. G. Barnard, brevet major general United States army, and Major Q. A. Gillmore, brevet *major general United States army.*—Nothing has been done at this battery during the year just closed beyond building a catch basin and trap, cleaning out the main drain thence near the light-house, and keeping the work in repair. The only work contemplated during the present fiscal year comprises the removal of the old shot furnaces from its terreplein, and some necessary grading and drainage.

No appropriation asked for the next fiscal year.

New casemated battery on Staten island, New York harbor, in charge of Colonel J. G. Barnard, brevet major general United States army, and Major Q. A. Gillmore, brevet major general United States army:—The construction of the work proper has not been begun, the preliminary preparations of previous years having been limited to the completion of a wharf for landing materials, the construction of a coffer-dam on the channel side of the site, to sundry borings in order to determine the nature and character of the substrata, to the purchase of stone, and cutting of rock-face ashlar, the preparation of stone for concrete to be used in foundations and piers of the work. The cutting of stone has been moderately continued through the year just closed.

No appropriation asked for the next fiscal year.

North Cliff battery, Staten island, New York harbor, in charge of Colonel J. G. Barnard, brevet major general United States army, and Major Q. A. Gillmore, brevet major general United States army.—At this work the operations in progress July 1, 1866, looked to the prompt completion of the battery and the mounting of its armament. Five platforms and the breast-height wall in front of them have been completed. The earth covering of the north traverse magazine has been completed and sodded, and the traverse itself finished. The settlement of the new earth-work at the south end of the battery has been made up by heavy filling, and the parapet roughly formed throughout the entire length of the battery. Excavations for the large magazine in the north end of the battery were commenced in April, and work thereon continued through the year. Two catch basins, with suitable drains through the parapet, were made, and a portion of the terreplein gutters paved. A sea-wall of dry rubble, six to seven feet in height, was built along the north half front, to prevent the washing of the exterior slope. The operations of the current year will be to construct the principal magazine in the north end of the battery, to form and finish the main slopes in rear thereof, and to complete the filling and prepare the foundations of the magazine and bomb-proof in the parados at the south end of the battery.

No appropriation asked for the next fiscal year.

South Cliff battery, Staten island, New York harbor, in charge of Colonel J. G. Barnard, brevet major general United States army, and Major Q. A. Gillmore, brevet major general United States army.—The completion of the main slopes in rear of this battery at the close of the last year left only the construction of the new magazine, which was in hand at that time, and the finishing up of the slope at the north end of the battery, to be carried on during the year just closed. The magazine was completed, and about one-third of the necessary earth covering placed over it, by the close of the last working season. This earth-work was resumed last spring, the slope at north end of battery formed and sodded, and the main slope repaired and top-dressed. The masonry work of the year was applied exclusively to the magazine. The operations of the present year will be limited to the interior fitting up of the magazine, the care and preservation of the slopes, and providing some necessary drainage.

No appropriation asked for the next fiscal year.

Fort at Sandy Hook, New Jersey, in charge of Lieutenant Colonel John Newton, brevet major general United States army.—Raising scarp of northeast bastion; north curtain casemate arches and communication arches in northeast bastion and north curtain constructed; piers of northwest front constructed;

additions made to walls of service magazines, &c., in northwest and southeast bastions. Upon the land front, taking up old work; excavating for foundations of scarp and piers of the new trace; laying foundations and building scarp wall and piers; embanking with sand to level of scarp.

It is proposed during the present season to complete the foundations of the scarp and piers of the land front, not including the caponniere, and raise the scarp uniformly four courses.

Jettees 2, 3, and 4 were lengthened respectively one hundred and eight, twenty-three, and eighty-nine feet. A wing thirty-three feet long and another twenty-seven feet long were added respectively to jettees 3 and 2, to protect these jettees from the action of eddy currents and northerly storms. A new jettee, No. 5, between 3 and 4, was built out sixty-five feet, and connected by a plank fence fifty-three feet long with the highest water mark.

A new jettee is necessary between Nos. 1 and 2, to protect the bulkhead constructed across the hollows between sand ridges from being undermined, but will not be undertaken this season unless indispensably necessary.

Appropriation asked for the next fiscal year, $150,000.

Fort Mifflin, Delaware river, Penn., in charge of Lieutenant Colonel C. S. Stewart.—The new main magazine has been completed; the old traverse stones have been removed, and new foundations and broad low traverse stones put in place for six barbette platforms; new traverse stones have been cut for barbette platforms to be modified; four thousand four hundred cubic yards of deposit in main ditch have been removed, wharf and river embankments repaired, &c. Similar operations of repair and melioration are contemplated for the next year.

Appropriation asked for the next fiscal year, $30,000.

Fort Delaware, Delaware river, Delaware, in charge of Lieutenant Colonel C. S. Stewart.—The southern dock wall has been extended one hundred and fifty-eight feet. The coping of parade wall of all the fronts has been pointed. The exterior slopes of parapets have been repaired and resodded throughout. The glacis has been regraded on all the fronts; the pond filled in; the exterior embankment of the island repaired and brought to its proper level for a length of two thousand three hundred and eighteen feet. Extensive repairs have been made to quarters, &c.

Appropriation asked for the next fiscal year, $60,000.

Battery opposite Fort Delaware, in charge of Lieutenant Colonel C. S. Stewart.—The platforms (temporary) of the fifteen-inch guns have been slightly repaired, and the traverse circles made level, so as to allow the guns to be rapidly manœuvred. Slight repairs, as needed, have been made to slopes and scarp.

No appropriation asked for the next fiscal year.

New fort opposite Fort Delaware.—Commencement of operations is deferred until the project for the work is revised.

No appropriation asked for the next fiscal year.

New fort near Delaware breakwater.—This work will be begun as soon as the best methods of applying iron to such constructions are determined on.

No appropriation asked for the next fiscal year.

Fort McHenry, Baltimore harbor, Maryland, in charge of Major William P. Craighill, brevet lieutenant colonel United States army.—The labor of the year has been applied entirely to the water battery. Re-enforcing of pintle centres for four front pintle platforms was completed, as also the substitution of the low for the high traverse circles for the same guns, which made the battery ready for its armament. The magazines and bomb-proofs and other traverses have been essentially completed. The thickening of the parapet and the rectification of its slopes, as well as the regrading of the terreplein, have been carried nearly to completion. The repairs of the water battery will be completed during the year 1867. Nothing is necessary for the main work.

No appropriation asked for the next fiscal year.

Fort Carroll, Baltimore harbor, Maryland, in charge of Major William P. Craighill, brevet lieutenant colonel United States army.—Operations have been very limited in extent, being confined almost entirely to keeping the fort in proper police, and protecting it in its unfinished state from the weather. A portion of the flagging for the floors of second tier has been received. Except on front 6 and the adjacent parts of 1 and 5, the scarp wall is at the height of the top of the twenty-third course of masonry, the floor arches of the second tier of casemates completed, and the piers built somewhat above the springing lines of floor arches of third tier of casemates, as originally designed. Front 6, on account of settlement, has been kept down to a level a little below the floors of first tier of casemates.

No appropriation asked for the next fiscal year.

Obstructions of the Potomac.—The preparation of *matériel* for this important object is in hand.

No appropriation asked for the next fiscal year.

Fort Washington, Maryland, in charge of Major John A. Tardy.—The modifications of this work should not be undertaken until the best manner of using iron in our defences is determined on.

No appropriation asked for the next fiscal year.

Fort Monroe, Old Point Comfort, Virginia, in charge of Colonel Henry Brewerton, brevet brigadier general United States army.—Operations for the year have been chiefly confined to necessary repairs. The traverse stones of barbette platform No. 93 have been taken up, the concrete foundation cut down, and the stones relaid one foot below the original level. Barbette platform No. 121 has been removed and replaced by a new one. The bridge at the north postern (front 6) has been repaired, and a portion of the stone pavement at the interior entrance of postern of front 4 taken up and relaid, so as to form a more gentle ascent. At the foot of this slope a drain has been constructed to carry off the surface water. The terreplein and ramps of the work have been regraded, gravelled, and thoroughly repaired.

Water Battery.—The brick masonry of the embrasures of six casemates has been repaired; the traverse circles in casemate 33 have been removed. Eighteen projectile platforms have been constructed for this battery.

It is proposed this year to widen the terreplein and increase the thickness of the parapets of the channel fronts of the main work, lay down new barbette platforms, and construct traverses and service magazines.

Appropriation asked for the next fiscal year, $100,000.

Fort Wool, Hampton Roads, Virginia, in charge of Colonel Henry Brewerton, brevet brigadier general United States army.—Operations have been very limited the past year, and have been confined for more than half the working season to preparations for building the magazines of the first tier at the capital at the east and west ends. The tenth course of scarp has been nearly completed from casemate 31 to 43 inclusive. The tablet course of the second tier of casemates has been laid at pier 40, and the second course of pier stones adjoining the scarp has been laid at the piers from 31 to 38. Portions of the wall in rear of casemates have been removed, preparatory to the construction of the magazines of the first tier. The sites of these magazines at the capital and at the east and west ends have been loaded with additional stones, the extension of these structures requiring this addition. The magazines of the first tier having been commenced, will be pushed forward to completion as rapidly as possible. It is proposed to expend the amount available in the construction of the magazines of the first tier at the capital and at the east and west ends, and on such other portions of the work as may hereafter be decided upon.

No appropriation asked for the next fiscal year.

Fort Clinch, Amelia island, Florida, in charge of Captain J. W. Barlow, *brevet lieutenant colonel United States army.*—The operations of the season have been mainly directed towards the construction of barbette gun platforms, those upon the sea fronts receiving the earliest attention. Four platforms, two upon the northeast and northwest curtains, respectively, have been completed, and are ready for their armament. Four other platforms upon the northeast and six upon the northwest curtains are also in readiness for their carriages, with the exception of setting traverse irons. These, with the centre pintle platform at the east angle, which is also completed, place the fort in a condition to receive the larger portion of its barbette armament. The foundations of breast height wall upon the above three fronts have been laid, and the concrete filling of the parapet, in conjunction therewith, raised to an equal height. The terreplein has been formed, graded, and planted with Bermuda grass. The exterior wall of parados has been built from the northwest angle along the northwest and part of the northeast curtains to the height of the springing line of the arch. This affords a permanent revetment for the rampart, and provides against endangering the security of the platforms by further excavation when the construction of the parados shall be recommenced. Considerable progress has been made upon other portions of the work. All the masonry and metal parts of the drawbridge below the reference of the bridge have been put in position, and the other material necessary for its completion purchased. About one-half of main sewer has been constructed. A large portion of the labor incident to the roofing of soldiers' barracks and store-house accomplished. It is deemed desirable to complete the remaining barbette platforms and gun parapets, to finish the superior slopes of bastionettes, construct the officers' quarters, and continue filling the glacis during the next season.

Appropriation asked for the next fiscal year, $50,000.

Fort Taylor, Key West, Florida, in charge of Major Walter McFarland.—The operations of the year have consisted in the removal of a part of the wreck left by the hurricane of 1865, the completion of the permanent sea-wall of the southern end of the coverface up to the high-water course, the construction of the outer breakwater at the northern end of the coverface and the commencement of its permanent sea-wall, the filling in of one-half of the enclosure at the southern end, the partial construction of the glacis of tower one, and the completion of the railroad to the coverface. The operations contemplated for the present fiscal year are the completion of the enclosure and filling of the coverface, and the continuation of the embankment of the glacis of tower No. 1.

Appropriation asked for the next fiscal year, $150,000.

Fort Jefferson, Garden Key, Tortugas, Florida, in charge of Major Walter McFarland.—The remainder of the appropriation for the past year was applied exclusively towards the completion of the officers' quarters; nearly the entire range was covered with galvanized iron, the iron stairways set up, and one section of the quarters completed except as to its hallways and piazzas. Sixteen platforms (barbette) were furnished with the new pattern pintle.

Appropriation asked for the next fiscal year, $100,000.

New fort at Tortugas, Florida.—This work will be commenced as soon as the best combination of materials for its uncovered scarps is determined on.

No appropriation asked for the next fiscal year.

Fort Pickens, Pensacola harbor, Florida, in charge of Major M. D. McAlester, brevet brigadier general United States army.—The general condition of this work is good. The magazines and gun platforms generally are in good condition. No operations have been carried on during the past year.

It is contemplated to construct at this work during the current fiscal year three barbette platforms for fifteen-inch guns, and to execute such repairs as may become necessary.

No appropriation asked for the next fiscal year.

Fort Morgan, eastern entrance to Mobile bay, Alabama, in charge of Major

M. D. McAlester, brevet brigadier general United States army.—This work is generally in good condition. As portions of the walls of the old defensive barrack in the parade, destroyed by the bombardment of August, 1864, are still standing, it is proposed to let them remain until the material composing them may be required for use. The counterscarp wall, southwest lunette, scarp and parapet of the land front, main gateway, parade walls and terrepleins of all the fronts, and leaden roof surfaces of casemates, have all been thoroughly repaired, and an extensive temporary breakwater to protect the site towards the west from encroachment of the sea has been constructed during the past year. No operations beyond ordinary repairs are contemplated during the current year.

No appropriation asked for the next fiscal year.

Fort on Ship island, coast of Mississippi, in charge of Major M. D. McAlester, brevet brigadier general United States army.—General condition is good, the work having during the year been completed as far as contemplated, and made ready for its armament. The magazines are in good order.

No appropriation asked for the next fiscal year.

Fort Jackson, Mississippi river, Louisiana, in charge of Major M. D. McAlester, brevet brigadier general United States army.—The general condition of the work is good. The magazines and platforms are, for the most part, serviceable. During the year twenty-two new barbette platforms for heavy guns, with the necessary modifications of breast height walls, parapets, terreplein, &c., have been completed, the casemates have been prepared for the reception of heavy guns, a new oven has been constructed, the new levee on the government reservation repaired, sixteen shot platforms finished, and two platforms for thirteen-inch mortars commenced. During the present year it is contemplated to erect a depot magazine capable of keeping powder perfectly secure against the great and sudden rises of water which occur at long intervals, due to freshets in the river, combined with overflows from the Gulf, caused by the violent storms incident to this region.

Appropriation asked for the next fiscal year, $75,000.

Fort St. Philip, Mississippi river, Louisiana, in charge of Major M. D. McAlester, brevet brigadier general United States army.—The general condition of this work is good. The gun platforms (excepting a few old ones) are in good order. The magazine in the lower battery is in excellent condition; the other two serviceable except during extraordinary storms. During the past year the magazine in the lower battery, fifteen new gun platforms, two mortar platforms, with the necessary modifications of parapets, breast-height walls, and terrepleins have been completed, and the bridge across the ditch and two gun platforms repaired. The principal operations contemplated for the current year are remodelling and repairing the magazines of the main work and upper battery.

Appropriation asked for the next fiscal year, $30,000.

Fort at Fort Point, entrance of San Francisco harbor, California, in charge of Major George H. Elliot.—The cleaning and painting of the embrasures of the main work have been completed. The main drain has been finished. The western sea-wall has been carried to the reference (14′.) The excavation for western casemated battery has been carried into the hill far enough to receive retaining wall of covered way. The excavation for the sea-wall along the eastern shore has been commenced. A heavy coffer-dam, necessary to the construction of the eastern fifteen-inch gun barbette battery and its sea-wall, has been carried three hundred and fifty feet along the shore. A railroad has been laid from the wharf head to the main work to transport materials to the sites of the new batteries. The workshops and storehouses have been removed to new sites to give place to the new barbette battery. The wharf has been extended and repaired. The roads have been repaired and protected from the encroachments of the sea. A large amount of granite for the eastern sea-wall has been obtained. The eastern fifteen-inch gun battery and the sea-wall in its front will be constructed during the present fiscal year; and, if possible, the casemate and barbette batteries on the western shore will be commenced.

Appropriation asked for the next fiscal year, $200,000.

Fort at Lime Point, San Francisco harbor, in charge of Major George H. Mendell, brevet colonel United States army.—Title to this site having been acquired by the United States, instructions to commence the preliminary operations of road and wharf making, preparation of temporary buildings for workmen, quarters, shops, and storehouses have been sent forward, and the work of excavating and blasting out a site for the defences will be entered upon without delay.

Appropriation asked for the next fiscal year, $100,000.

Fort at Alcatraz island, San Francisco harbor, California, in charge of Major George H. Elliot and Major G. H. Mendell, brevet colonel United States army.—Owing to want of means, work on Alcatraz was suspended in February, and the barrack placed in condition to lie over, under charge of a keeper. Previous to that time the masonry of the first tier of the barrack was completed, and that of the rear rooms of the second tier was more than half done, while the long piers of the casemate arches of the second tier and the parade walls were carried to the height of the springing lines. The scarp is about one foot above the crown of the arches of the second tier. No work has been done on the arches since December. A large amount of rock excavation has been made, mainly in the extension of battery Rosecrans, which is now ready for the masonry. A careful resurvey of the island is in progress.

Appropriation asked for the next fiscal year, $50,000.

Survey at Point Lobos, California, in charge of Major George H. Elliot.—The survey of this position, as a site for defensive works, was commenced in May, 1866, and completed, including the maps and report, in April, 1867. The area included is somewhat over a square mile. All the particulars required have been obtained and are presented on the maps.

No appropriation asked for the next fiscal year.

Survey for land defences at San Francisco, in charge of Major George H. Elliot.—The winter season being rainy and unsuitable for this work in the climate of California, the survey was not commenced until the middle of March. It has been in progress since then, with the aid of a party of the Coast Survey which had already covered a part of the ground with their operations. Preliminary tracings showing the progress of the work have been received, and it is expected to be completed during the present fall.

No appropriation asked for the next fiscal year.

Military Academy.—By the law of July 13, 1866, it was enacted, "That the superintendent of the United States Military Academy may hereafter be selected, and the officers on duty at that institution detailed from any arm of the service; and the supervision and charge of the academy shall be in the War Department, under such officer or officers as the Secretary of War may assign to that duty;" and by General Order No. 54, Adjutant General's office, of July 30, 1866, the Chief of Engineers was relieved from duty as inspector of the academy, and directed to turn over all the books, records and papers relating thereto to the Adjutant General of the army.

This order has been complied with, and the Military Academy is separated from the corps of engineers. It had been a part of that corps, by law, for more than sixty-four years.

Engineer battalion, commanded by Major Henry L. Abbot, brevet brigadier general United States army.—The strength of the five companies of engineer troops, on the 30th June, 1867, was six hundred and sixteen enlisted men and fourteen officers; one hundred and thirty-six recruits were needed to complete the organization.

By the law of July 28, 1866, section 20, the five companies were constituted a battalion of engineers, to be officered by officers detailed from the corps of engineers.

The battalion should have a commissary sergeant and two principal musicians. Its strength is seven hundred and fifty-two men, about the same as a regiment of infantry. By the operation of the 7th section of the act of July 13, 1866, the enlisted men of the engineers are denied the allowance of the per diem paid to other soldiers when engaged in continuous labor. This discrimination should be removed; it operates to restrain superior men from enlisting in the battalion.

A small appropriation is needed to procure materials required to instruct the men in their duties as engineer soldiers.

These several points will be made the subject of a special communication in season for legislative action.

Three companies of these troops are stationed at Willett's Point, New York; one at the engineer depot, Jefferson Barracks, Missouri, commanded by Captain William Ludlow, brevet lieutenant colonel United States army, and one commanded by Captain Samuel M. Mansfield, brevet lieutenant colonel United States army, is en route for San Francisco, California. A detachment is at West Point, New York, for the purpose of affording instruction in practical engineering to the cadets of the Military Academy.

Engineer depots at Willett's Point, New York, and Jefferson Barracks, Missouri, in charge respectively of Major H. L. Abbot, brevet brigadier general United States army, and Captain William Ludlow, brevet lieutenant colonel United States army.—A large amount of engineer *matériel* is collected at these two depots. It is guarded and cared for by the companies above mentioned, and affords them the means of drilling at, and acquiring a knowledge of, their peculiar functions.

For the construction of barracks for the officers and men at Willett's Point and Jefferson Barracks, appropriations were asked last year of twenty-five thousand dollars for the former, and twenty thousand dollars for the latter place. Congress granted these sums, but directed the use of half of each only, during the present fiscal year, withholding the remainder until further determination by them on the subject. The appropriation of these balances for the next fiscal year, viz., twelve thousand five hundred dollars for Willett's Point, and ten thousand dollars for Jefferson Barracks, is asked in the annual estimate of this office.

RIVER AND HARBOR IMPROVEMENT.

The last annual report alluded to the measures that had been taken to carry into effect the act of Congress approved June 23, 1866, making appropriations for repair, &c., of works of improvement which had been heretofore authorized, and requiring the examination and survey of other localities. The assignment of officers to the charge of these works and the progress of the operations, so far as reports had been received, was also presented.

Subsequent thereto, in accordance with the requirements of the act referred to, "at the earliest practicable time to report to Congress the result of any survey or re-survey, with the plan adopted and the items of expenditure under said plan, and * * * of all action taken under the provisions of this act, * * * make such a report at the commencement of every session of Congress until the works herein provided for shall all be completed," a special report was made to the Secretary of War on the 26th of January, 1867, which was submitted to Congress and is found in printed Executive Document 56, House of Representatives, thirty-ninth Congress, second session. It embraces reports upon sixty-three works of improvement, both of rivers and harbors.

A special report upon the survey, examination, and improvement of the Upper Mississippi river and its tributaries, covering a length of river course of more than one thousand miles, was submitted on the 29th of January, 1867, was printed, and is found in Executive Document 58, House of Representatives, thirty-ninth Congress, second session.

The following reports were also submitted, namely:

Upon the harbors of Pere Marquette and Pentwater, on Lake Michigan, on the 2d of February, 1867, printed Executive Document 70, House of Representatives, thirty-ninth Congress, second session.

Upon the harbor of Ontonagon, Lake Superior, on the 5th of February, 1867; printed Executive Document 80, House of Representatives, thirty-ninth Congress, second session.

On the survey and improvement of the Des Moines and Rock Island rapids of the Mississippi river, on the 5th of February, 1867, printed Executive Document 79, House of Representatives, thirty-ninth Congress, second session.

On the survey and improvement at Hell Gate, New York, on the 9th of February, 1867, printed Executive Document 90, House of Representatives, thirty-ninth Congress, second session.

On the survey and improvement of the Kennebec and Penobscot rivers, Maine, printed Executive Document 91, House of Representatives, thirty-ninth Congress, second session.

On the survey and improvement of Plattsburg harbor, New York, on 13th of February, 1867, printed Executive Document 89, House of Representatives, thirty-ninth Congress, second session.

On the encroachments upon the harbor of New York, on the 15th of February, 1867, printed Executive Document 28, Senate, thirty-ninth Congress, second session.

On the survey and improvement of Rock river, Illinois and Wisconsin, on the 11th of April, 1867, printed Executive Document 15, House of Representatives, fortieth Congress, first session.

On the survey and improvement of Illinois river, Illinois, on the 13th of May, 1867, printed Executive Document 16, House of Representatives, fortieth Congress, first session.

In addition to the foregoing, special reports were made, but not printed, upon the survey and improvement of the following localities, in obedience to resolutions of the Senate or House of Representatives, or on the call of the committees, namely:

On the harbor at Point Sal, California, on the 1st of February, 1867.

On the practicability of steamboat navigation from Chesapeake Bay to Lake Ontario, and estimate for a survey of the route, on the 7th of February, 1867.

On the works necessary for the preservation and improvement of Boston harbor, on the 11th of February, 1867.

On the improvement of Kalamazoo river, Michigan, on the 13th of February, 1867.

On the improvement of Willamette river, Oregon, on the 14th of February, 1867.

On the survey of Galveston harbor, Texas, on the 16th of February, 1867.

On the increased depths to be given to the harbors on the lakes, to admit vessels drawing fourteen feet water, on the 19th of February, 1867.

On the changes in the channel of Potomac river, from Georgetown to Greenleaf's Point, on the 21st of February, 1867.

On the selection of a position for a breakwater or harbor of refuge at Block island, Rhode Island, on the 23d of February, 1867.

The information furnished in the above reports resulted in the appropriation of funds for the improvement of the harbors or rivers which formed the subject of those communications, or in the provision for surveys or examination of other localities, with a view to their improvement.

Measures were taken immediately upon the passage of the act of Congress, approved March 2, 1867, for the execution of its provisions, and the results of these measures as well as the progress of the works appropriated for in June, 1866, are embraced in these reports, so far as the information has been obtained.

Special communications will be made upon the surveys in progress, but not completed, as soon as the reports are received.

The surveys are:

1. For a ship canal connecting Lakes Erie and Ontario, under the charge of Brevet Colonel C. E. Blunt.
2. Of the Ohio river, in connection with its improvement, in charge of Mr. W. Milnor Roberts, United States civil engineer.
3. For a ship canal around the falls of the Ohio, in charge of Brevet Major General G. Weitzel.
4. Of the Tennessee river, in charge of Brevet Major General G. Weitzel.
5. Of the Illinois river, with a view to its improvement and to its connection by a ship canal with Lake Michigan, in charge of Lieutenant Colonel and Brevet Major General J. H. Wilson.
6. Of the Mississippi river, above Rock Island rapids, with a view to its improvement, and between St. Paul and St. Louis, with a view to the location of bridges, and above the falls of St. Anthony, &c., in charge of Brevet Major General G. K. Warren.
7. Of the harbor of Port Clinton, Ohio, in charge of Brevet Major General T. J. Cram.
8. Of the Connecticut river, between Hartford and its mouth, in charge of Brevet Colonel D. C. Houston.
9. At Block island, in the State of Rhode Island, with a view to a harbor of refuge, in charge of Brevet Colonel D. C. Houston.
10. At Reedy island and Listen Tree, in Delaware river, in charge of Lieutenant Colonel Charles S. Stewart.
11. Of the Potomac river, in the District of Columbia, in charge of Brevet Brigadier General N. Michler.
12. Of the bay and harbor of Galveston, Texas, in charge of Brevet Brigadier General M. D. McAlester.

Further legislation is very desirable to carry into effect more advantageously the provisions of the recent river and harbor bill. Serious difficulties, delays, and embarrassments attend the execution of some of the provisions of the acts of June, 1866, and March, 1867, for those objects.

It is suggested that the acts be amended so as to authorize the Secretary of War to apply the sums appropriated therein by contract or otherwise than by contract, when in his judgment it may best subserve the interests of the government to do so, and that the same provision be made for the application of any sums that may be appropriated by Congress at its approaching session.

As an illustration of the embarrassments and delays incident to the execution of the law, it is to be observed that the acts require each class of material, as timber, iron, stone, and brush, and each class of labor on such material, as carpentry, smithery, masonry, and ordinary labor, to be contracted for separately. With every effort to simplify the work and reduce the number of classes, especially those of labor, it has been found in some instances impracticable to bring each class together at proper times.

It is to be further observed that there are cases where, from the destructive effects of storms, or from wrecks in the channels, the delay in procuring material and labor for the object by means of contracts, after soliciting proposals by advertisements, leads to serious injuries to the works.

With the exception of some of the greater works of improvement, there has been but little competition manifested by bidders.

The objections to the exclusive use of the contract system in carrying on these improvements were presented in some detail in the last annual report, and particularly in a report to the Secretary of War of January 24th, 1867, on a letter from the chairman of the Committee on Commerce of the Senate.

It will be found, by reference to the reports appended hereto, that further experience does not diminish the difficulties.

The number of copies of the reports emanating from these headquarters upon subjects purely of engineering nature, and ordered to be printed, allotted by law for its use and for distribution to officers and agents, is too small for the intended purposes. It is therefore recommended that the Superintendent of Congressional Printing be directed by resolution to increase the number from one hundred copies, (the number now allowed by law,) to two hundred copies.

There is herewith submitted a summary of the operations at each of the localities where surveys and improvements are in progress, showing the progress of the work since the last annual or special report was rendered, up to the close of the fiscal year, and containing recommendations for further appropriations for carrying into effect the improvements authorized by Congress.

The reports of the engineers in charge of the improvements, made in accordance with the following circular, and with the requirements of the law, are also appended. Attention is respectfully invited to them for full details of the work during the last fiscal year:

[Circular No. 11.]

ENGINEER DEPARTMENT,
Washington, June 10, 1867.

Your annual report of progress in all works of river and harbor improvements and surveys in your charge, must be transmitted so as to reach this department by the 15th of September next, and should be accompanied by a brief or synopsis of its contents, to be embodied in the report of the Chief of Engineers.

Your attention is also invited, at the same time, to sections 2 and 3 of the act making appropriations for the repair, preservation, and completion of certain public works, &c., &c., approved June 23, 1866, and to section 2 of the act (for the same purpose) of March 2, 1867, with the view of reporting to Congress on the following points, to be embraced in your annual reports, namely:

1. Result of survey or resurvey, with plan adopted, and items of expenditure under that plan.
2. The amount that is required for the entire and permanent completion of each work under your charge.
3. The amount that can be profitably expended upon each work during the next fiscal year.
4. The collection district in which each work is located.
5. At or near what port of entry, light-house, or fort, each work is located.
6. What amount of revenue was collected at the nearest port of entry to each work for the last fiscal year.
7. As far as practicable, what amount of commerce and navigation would be benefited by the completion of each particular work.
8. Abstract of proposals for each work, with names of bidders.
9. Abstract of contracts for each work, with names of contractors.
10. Abstract of contracts for each class of materials or labor for each work.

Where the nature of the work is such as not to admit of permanent completion, a plan and estimate should be submitted as to the perpetual annual expenditure required to maintain the harbors and rivers in the condition contemplated in the plan of improvement; or, if the maintenance of the improved condition does not require an annual expenditure, then the probable periods at which the preservation of the works and maintenance of depth of water will require expenditures of money, and the amount of such expenditure.

A. A. HUMPHREYS,
Chief of Engineers, Major General.

LAKE HARBORS.

HARBORS ON LAKES SUPERIOR AND MICHIGAN.

Officer in charge Brevet Colonel J. B. Wheeler, major corps of engineers, who has assigned the officers under his orders to the following duties:

Captain A. MacKenzie, corps of engineers, special superintendent for the harbors of Black Lake, Grand Haven, Muskegon, White River, Pentwater, Pere Marquette, Manistee, and Aux Becs Scies.

Captain D. P. Heap, corps of engineers, special superintendent for the harbors of Milwaukee, Racine, Kenosha, Chicago, Michigan City, New Buffalo, St. Joseph, and South Haven.

Lieutenant J. B. Quinn, corps of engineers, special superintendent for the harbors of Marquette, mouth of Fox river, Green Bay, Manistee, Sheboygan.

Assistant Henry Bacon, special superintendent for the harbors of Superior City, Ontonagon, and Eagle Harbor.

Assistants W. T. Casgrain and W. H. Hearding, engaged in surveys and the preparation of maps.

I.—*Lake Superior.*

1. SUPERIOR CITY HARBOR, WISCONSIN.

The original plan contemplates piers composed of two rows of piles, fifteen feet apart, capped with timber, forming a crib superstructure, and filled with stone; an estimate for which was submitted in the report from this office of January 26, 1867, amounting to $178,000.

After some delay, arising from the failure of bidders to comply with their bids, contracts were finally entered into, and the work is now in progress.

Amount appropriated by act of March 2, 1867	$63,000 00
Amount required for the next fiscal year	100,000 00

(See Appendix A 1.)

2. ONTONAGON HARBOR, LAKE SUPERIOR.

The plan recommended for this harbor is to extend two parallel piers, composed of cribs ballasted with stone, from the mouth of the river outward into the lake, a distance of 2,160 feet for the west pier, and 2,340 for the east pier. The direction of the piers to be the same as that of the present west pier.

The total estimated cost was	$292,801 50
And there was appropriated in 1867	97,600 00
Amount required to complete the work	195,201 50
Amount required for next fiscal year	97,600 00

Contracts were entered into in the latter part of June, 1867.

(See Appendix A 2.)

3. EAGLE HARBOR, LAKE SUPERIOR.

The plan proposed is to remove the rock that forms a bar in the entrance, and to build breakwaters from the eastern and western points, in order to narrow the entrance to the harbor.

There were 1,803 cubic yards of trap rock to be removed in order to attain the depth of 14 feet of water, and 1,290 running feet of pier work to be built in order to improve the harbor.

Advertisements were inserted in the newspapers calling for proposals to do the work.

The proposals were opened on the 20th of June, but the price in the lowest bid for removing the rock being unreasonably high, all bids were rejected, and proposals were again invited, and this time for removing the rock only. These proposals were opened on the 31st of July, and the contract was awarded, the work to be commenced without delay and prosecuted during the winter.

The estimate for doing this was	$191,189 86
There was appropriated	65,000 00
Amount required to complete the work	126,189 86
Amount required for next fiscal year	66,000 00

4. MARQUETTE HARBOR, LAKE SUPERIOR.

The contractors have commenced work upon the breakwater, and fair progress may be expected during this season.

The estimated cost of the improvement is	$385,129 58
The sum appropriated is	85,000 00
The sum that can be profitably expended during the next fiscal year is	100,000 00

(See Appendix A 3.)

II.—*Lake Michigan.*

5. HARBOR OF GREEN BAY, WISCONSIN.

During the present season more than 30,000 cubic yards of earth and sand have been removed, giving a cut 12 feet deep across Grass island. It is expected that by the close of the working season a channel of this depth, 100 feet wide, will be opened, as well as one of the same depth from 12 feet water on the south to 12 feet water on the north side of the island.

The revetment of the cut will be postponed until the action of the ordinary current and the effect of freshets upon the new cut are ascertained.

The engineer in charge recommends that instead of sheet-piling, as originally proposed, the cut across the island and in shoal water be revetted with close piling, as more durable work; and in deep water on the north side and at both ends of the cut, that pier work composed of cribs ballasted with stone be used.

A decision upon this modification is reserved until further information is obtained.

The estimated cost of the present improvement was	$155,416 17
Amount already appropriated	75,500 00
Amount required for next fiscal year	80,000 00

(See Appendix A 4.)

6. HARBOR OF MANITOWOC, WISCONSIN.

The plan adopted for the improvement of this harbor is to extend two parallel piers outward into Lake Michigan until a depth of 12 feet is obtained, and to dredge the waterway between the piers to the same depth. The piers to be composed of cribs ballasted with stone.

This work is under contract and progressing well.

At the date of Colonel Wheeler's report there had been expended $40,324 72 for labor and materials, and 576 feet of piers had been constructed. 960 feet in all will be completed during the present season, provided the weather is favorable.

The estimated cost of the work was	$141,747 82
Amount already appropriated	97,000 00
Amount necessary to complete, and required for next fiscal year	45,000 00

(See Appendix A 5.)

7. HARBOR OF SHEBOYGAN, WISCONSIN.

The plan adopted for this harbor was to extend the north pier 120 feet, the south pier 320 feet, and to dredge the channel between the piers.

For this purpose there was appropriated, in 1866, $47,598 91, and in 1867 an additional appropriation was made of $8,000.

The greater part of this sum has been expended in completing the piers as proposed, and the work will be finished this season.

The engineer in charge recommends, as a further improvement of this harbor, that the piers be extended into the lake across the present outer bar, opposite the entrance of the river. This will require 416 running feet of additional pier work and some dredging, at an estimated cost of $49,000, which can be profitably expended during the next fiscal year. This recommendation is approved.

(See Appendix A 6.)

8. HARBOR OF MILWAUKEE, WISCONSIN.

The only work done at this harbor during the present year was the filling up of the cribs with stone. The stone having settled considerably through the grillage bottoms, or having been taken away, it was considered necessary to replace it.

The general condition of the work, upon close examination, has been found to be good, but there are evidences of decay—a necessary consequence of using timber above the water surface. The portion above the water must be replaced in the course of a few years.

A bar from the northward is encroaching upon the entrance of this harbor and threatening to injure it seriously.

An extension of both piers 300 feet would postpone for many years the injurious results now threatened. This extension is therefore recommended by the engineer in charge, at a cost of $65,872 80. Deducting present balance of appropriation on hand, $38,354 53, would leave, say $28,000, which could be profitably expended during the next fiscal year. The recommendation is approved.

(See Appendix A 7.)

9. HARBOR OF RACINE, WISCONSIN.

The plan for this harbor is to extend both piers, composed of cribs ballasted with stone, until a depth of 15 feet of water is reached, and to dredge between the piers until 12 feet is obtained throughout.

Due notice having been given, the bids were opened, and contracts entered into for prolonging the north pier the required distance.

The engineer in charge recommends dredging between the piers to a depth of 14 feet. The estimated cost of this improvement was $84,172 48; the amount appropriated was $45,000; amount required to complete the work, $39,172 48; add for additional dredging, $5,000; amount which can be profitably expended during the next fiscal year, $45,000. The recommendation is approved.

(See Appendix A 8.)

10. HARBOR OF KENOSHA, WISCONSIN.

During the present season the contractors have extended the south pier 352 feet, and will complete the extension of the north pier 192 feet.

A depth of 12 feet has been obtained throughout the greater part of the water-way, between the piers, by dredging. The old piers are in bad condition, and require rebuilding from the water surface. The basin inside is very shallow.

The engineer in charge does not consider it necessary to extend the piers further at the present time, but thinks it proper to repair the old work and dredge the basin to the depth of 10 feet; for which he estimates—

For repairs of old pier work	$20,000 00
For dredging required in basin	35,000 00
Total	55,000 00

He asks an additional appropriation for the next fiscal year of $40,000. (See Appendix A 9.)

11. HARBOR OF CHICAGO, ILLINOIS.

In 1865 the plan recommended by Colonel Cram was to extend the north pier 600 feet, and rebuilding the south pier to extend it 610 feet. Under the expectation that 110 feet of the northern extension would be done by the city authorities, his estimates were made for adding 490 feet only to the north pier. The estimated cost for the entire work was $88,704, which sum was appropriated. But, as heretofore reported, this amount was found to be inadequate to the whole work.

The extension of the north pier was contracted for in October, 1866. Before work was commenced this season, the Chicago Canal and Dock Company submitted for approval their project for an entrance to their basin at the end of the present north pier. This application was favorably recommended to the Secretary of War from this office, and the authority asked for was granted. This company have guaranteed to close in the basin extending to the north and east of the present pier before the end of the working season. It is expected that the north pier will be extended 300 feet before the season closes.

The engineer in charge recommends that this pier be extended only 300 feet, and that the balance of the appropriation be expended upon the south pier, the extension of which, as proposed, will require an additional appropriation of $48,000. This amount can be profitably expended in the next fiscal year. The recommendation is approved.

(See Appendix A 10 and A 11.)

12. HARBOR OF MICHIGAN CITY, INDIANA.

It having been satisfactorily shown that the Michigan City Harbor Company had expended $100,000 upon this harbor, as required by Congress before the appropriation of $75,000 could be available, the work was let on the 7th of August, and the contractors are under bonds to furnish materials and build not less than 128 running feet of pier work this year.

The improvement proposed for this harbor is to extend the northeastern pier 288 feet on a line with its present direction, extend the western pier 320 feet on a line with direction of present end crib, and dredge the channel between the piers to a depth of twelve feet. The dredging is done by the steam-dredge belonging to the harbor company, the United States paying all the running expenses.

The materials for the piers, and labor, have been contracted for.

(See Appendix A 12, A 13, A 14.)

13. HARBOR OF NEW BUFFALO, MICHIGAN.

The sum of $60,000 was appropriated for the improvement of this harbor. The plan of improvement is that recommended by the late Colonel Graham, United States corps of engineers, the estimated cost of which was $384,020.

Contracts have been entered into, and the contractors are at work excavating the cut. They will remove this year not less than 50,000 cubic yards of sand.

From a recent inspection of this harbor, the engineer in charge reports unfavorably upon the practicability of keeping it open, without a large annual expenditure, after the costly harbor works proposed have been completed. The project will be referred to a board of engineers before the resumption of operations in the spring.

Should the work be continued, the sum required for the next fiscal year will be $110,000.

(See Appendix A 15.)

14. THE HARBOR OF ST. JOSEPH, MICHIGAN.

During the present year the old piers have been repaired, and the south pier extended. The extension was 200 feet, using a pile foundation with rib superstructure, and filling the pier with brush and stone. Greater strength has been given to this pier than was originally intended.

The engineer in charge recommends that the south pier be extended 700 feet. The cost of this extension, using the pile structure, would be $49,000; if cribs be used, the cost will be $77,000. This extension is necessary for the preservation of the channel. The project is approved, and it is recommended that there be appropriated, to be expended during the next fiscal year, in extending the south pier, the sum of $77,000.

(See Appendix A 16.)

15. SOUTH HAVEN HARBOR, MICHIGAN.

Contracts have been entered into for material and labor for the construction of two piers, extending into the lake a total distance of 640 feet, and require that not less than 200 feet shall be completed on or before the 31st of October, 1867.

Proposals for removal of the old south pier, and for dredging the channel between the piers, have not yet been invited. The work of improvement is progressing in accordance with the plan proposed in the report submitted January 26, 1867, for which an estimate was presented, amounting to $129,000.

Amount appropriated	$43,000 00
Amount required next fiscal year	43,000 00

(See Appendix A 17.)

16. BLACK LAKE HARBOR, MICHIGAN.

The plan of improvement is the extension of the piers, and dredging the channel between the piers. This work has been contracted for, and will be completed in 1868.

(See Appendix A 18.)

17. GRAND HAVEN HARBOR, MICHIGAN.

During the present year the south pier has been extended 192 feet into the lake, and about 500 feet of close piling has been constructed. The present appropriation will complete the close piling and the present pier.

The engineer in charge recommends that the building of the north pier should not be deferred. This recommendation is approved.

The estimated cost of this pier is	$200,000 00
Amount that can be profitably expended during the next fiscal year	75,000 00

(See Appendix A 19.)

18. MUSKEGON HARBOR, LAKE MICHIGAN.

The plan proposed was to extend the present piers to 17 feet water. The estimated cost was $58,450. This amount was appropriated, and will build the piers.

The engineer in charge recommends that the upper portion of the present slab piers be replaced by a crib superstructure, ballasted with stone, as the slab pier is liable to be burnt. The cost of this improvement is estimated at $64,000. There appears to be no immediate necessity for this expenditure. An appropriation for the next fiscal year is not, therefore, recommended.

(See Appendix A 20.)

19. WHITE RIVER HARBOR, LAKE MICHIGAN.

The sum of $57,000 was appropriated in 1867 for the improvement of this harbor. The plan adopted is to cut a new channel across the neck of land separating the two lakes, at a distance of 1,200 yards from the present outlet of White river. The contractors are at work, and unless some unforeseen difficulties arise, the cut of the proper width and depth will be made before the season closes.

The estimated cost was	$170, 530 80
Amount appropriated for the present fiscal year	57, 000 00
Amount required for the next fiscal year	75, 000 00

(See Appendix A 21.)

20. PENTWATER HARBOR, LAKE MICHIGAN.

The plan adopted for the improvement of this harbor was to increase the width of the present outlet from 76 feet to 150 feet, and to dredge to a depth of 12 feet throughout its entire length, which involves the removal of 127,028 cubic yards of earth and sand, and the construction of 2,120 running feet of close piling and 2,560 running feet of pier work, at an estimated cost of $327,713 40.

Contracts for material, dredging, and building a pier of 768 feet in length have been entered into.

Amount appropriated for the present fiscal year	$55,000 00
Amount required for the next fiscal year	100,000 00

(See Appendix A 22.)

21. PERE MARQUETTE HARBOR, LAKE MICHIGAN.

Two localities were proposed for the channel to the inner lake. One the present entrance, the other distant from it nearly a mile.

The estimated cost was as follows, viz: Improvement at first or present entrance, $270,682 16; improvement at second or new cut, $269,136 49.

As the two estimates were equal in amount, and as the sum appropriated could be expended to greater advantage at the present entrance, that locality was adopted. The contractors have pushed the work with vigor, and have placed 14 cribs in position (nearly 450 feet of pier work) this season, and expect to finish as much more before the season closes.

There was appropriated for the present fiscal year	$50,000 00
Amount required for next fiscal year	75,000 00

(See Appendix A 23.)

22. MANISTEE HARBOR, MICHIGAN.

The plan of improvement adopted at this harbor was to extend the south pier in its present direction 960 feet; to commence the extension of the north pier, at a point opposite the outer end of the old south pier, and extend it in a direction parallel to the south pier a like distance of 960 feet, to 12 feet water; to cut down all slab work to the water surface, and build crib work on the old foundation.

Since the survey of September, 1866, 100 feet of the old north pier has been washed away, causing a slight change in plan, the north pier being thrown 20 feet further to the north, and the work upon it commenced at end of old pier.

Contracts have been entered into for building and sinking 24 cribs, (768 feet linear, in extension of the north pier,) and not less than 8 cribs to be sunk the present season.

The estimate for the completion of the harbor was	$181,000 00
Appropriation for present fiscal year	60,000 00
Amount required for next fiscal year	60,000 00

(See Appendix A 24.)

23. HARBOR OF AUX BECS SCIES, MICHIGAN.

A resurvey recently made of this harbor shows that to improve it as contemplated, by extending the piers to a depth of 12 feet, an additional length of 384 feet of crib work and 150 feet of close piling will be necessary, which, with the increase of the cost of dredging over that estimated for, will require a further appropriation of $48,000.

Contracts were entered into, and the work has progressed very satisfactorily. It is expected by the end of the season that the cut will be completed, the channel close piled, and 480 feet of cribs constructed.

Whole estimated cost of work resulting from resurvey	$146,400 00
Amount already appropriated	98,541 00
Amount required to be appropriated for next fiscal year	48,000 00

(See Appendix A 25.)

24. SURVEY OF MICHIGAN CITY HARBOR, INDIANA.

This harbor was surveyed in April, 1867, by Captain A. MacKenzie, United States engineers, and a tracing of the map of the harbor, with his report upon the condition of the piers and other works, has been received.

25. SURVEY OF RACINE REEFS, HARBOR OF RACINE, WISCONSIN.

The object of this survey was to ascertain the practicability and necessity of constructing a light-house and breakwater on the reefs.

The survey was attended with difficulty and expense. The reef is nearly two miles from the entrance to the harbor, and is exposed to the open waters of the lake. It is a dangerous obstacle to navigation; a season rarely passes without vessels running upon it. These accidents happen mostly to vessels not bound to the harbor of Racine, but coasting near the shore.

The construction of a light-house with breakwater would be costly. Assuming as a guide the light-houses on Waugoshance shoal and Skilligallee rock, these points being similar in exposure to Racine reef, the cost of building a suitable light-house and breakwater around the house is estimated at about $175,000.

Considering the large amount of this first outlay, and the subsequent annual expenditure to keep it in order, &c., the engineer in charge considers it questionable whether the case would justify the expenditure, and suggests as a substitute a large can-buoy, firmly anchored on the reef, to warn off vessels during the day, and a combination of range lights with the present light at the entrance to the harbor, and one on Wind Point, to warn them at night. Some such plan he therefore recommends.

(See Appendix A 26.)

26. SURVEY OF SAUGATUCK HARBOR, MOUTH OF KALAMAZOO RIVER, MICHIGAN.

A report upon the capacity of this harbor and plan of improvement are given in appendix.

The engineer in charge states that it will be seen by reference to this report and map that the residents of that locality have expended their means freely in improving the entrance. The plan adopted by the residents is to confine the waters of the river by parallel piers built of slabs, having a direction S 83 W.

The engineer in charge recommends the continuance of this improvement, so as to make this a harbor of refuge. To do this these piers should be extended until a depth of 12 feet of water is reached, and the waterway between the piers should be dredged to the same depth. The piers should be built of cribs, ballasted with stone, and the tops of the present piers should be removed to the surface of the water, and a crib superstructure, filled with stone, placed thereon.

The estimated cost is $202,295 80; required for the next fiscal year $67,500. The project is approved.

(See Appendix A 27.)

27. SURVEY OF THE MOUTH OF THE MENOMONEE RIVER, GREEN BAY.

The survey of this harbor was completed in August, and a plan submitted for its improvement.

In consequence of the shifting sand bar across the mouth of the present channel, its improvement was considered impracticable, and it was therefore proposed to cut through the neck of land between Green bay and the Menomonee river, and build two parallel piers in a due east direction, 1,375 feet in length on the north, and 1,275 feet on the south side, respectively, and to dredge a basin inside the river to a depth of 12 feet, at an estimated cost of $252,571.

In the opinion of the engineer in charge commerce generally would not be benefited by the improvement of this harbor.

(See Appendix A 28.)

III.—*Harbors on Lakes Huron and Erie, and improvement of the St. Mary's river and the St. Clair flats.*

Officer in charge, Brevet Major General T. J. Cram, colonel of engineers, having under his orders Brevet Lieutenant Colonel F. Harwood, captain corps of engineers, and Captain G. J. Lydecker, corps of engineers.

1. IMPROVEMENT OF THE ST. MARY'S RIVER, MICHIGAN.

The contract for dredging the channel of this river not having been concluded until October of last year, it was not deemed practicable to commence operations at so late a period, and therefore the work was not entered upon until the opening of navigation the present year, in June. Since that time the work has progressed very satisfactorily.

The amount already appropriated is..........................	$100,000 00
The amount required for next fiscal year	324,000 00

(See Appendix B.)

2. AU SABLE RIVER, LAKE HURON, MICHIGAN.

Proposals were advertised for this improvement, but no contract concluded up to June 30, 1867.

Amount therefore available July 1, $50,000.

A closer estimate has been made for completing this improvement, based upon the bids already received, from which the officer in charge, Brevet Major General Cram, concludes the whole cost to be $69,367. Hence, additional appropriation will be required of $19,367.

(See Appendix B, B 1, and B 2.)

3. IMPROVEMENT OF THE MOUTH OF THE SAGINAW RIVER, MICHIGAN.

A contract for dredging was made in October, 1866, but owing to the lateness of the season no work was done until the following May, when, owing to the dredge-boat having been driven ashore in a gale, the work was further delayed until June 15. From that time to June 30, 3,426 cubic yards of very hard material were raised, composed chiefly of hard conglomerate clay and gravel. The engineer in charge reports that notwithstanding the hardness of the material, the work is progressing very satisfactorily. There is no doubt that during the present working season a channel will be opened to admit vessels drawing 10 feet water. Eventually, the portion to be dredged will have a depth of 12 feet.

No additional appropriation is required.

(See Appendix B)

4. LAKE ST. CLAIR—SAINT CLAIR FLATS.

The act of Congress of March 2, 1867, directed an appropriation of $150,000 to be expended upon a straight cut or canal 300 feet wide and 13 feet deep, from deep water at the entrance of the South Pass, to sufficiently deep water in Lake St. Clair, a distance of about one and a half mile.

Proposals were advertised for, but no contracts made up to the 30th of June, 1867. Since that time contracts have been entered into under new proposals, the work to be commenced in September.

Amount available June 30, 1867	$229,970 32
Probable amount required for the improvement	428,754 00
Additional appropriation required, which should be made available for the next fiscal year	200,000 00

(See Appendix B, and from B 3 to B 18 inclusive.)

5. MONROE, MICHIGAN.

Contracts were entered into October, 1866. The delivery of materials, and the work of repair, were carried on during the winter. All the exterior under-water work upon the south pier was securely put in before the spring.

At the end of the fiscal year there had been expended $6,760 06, leaving available, July 1, 1867, $24,255 21. At the present contract prices the cost of the repairs and new work will be $12,484 30; leaving a balance to be applied hereafter, as circumstances may develop, of $12,770 65.

No additional appropriation required.

(See Appendix B.)

6. HARBOR OF TOLEDO, MAUMEE BAY, OHIO.

A contract for deepening the existing channel to a depth of 12 feet, with a width of 200 feet, was entered into October 12, 1866. Up to the end of the fiscal year, June 30, 16,236 cubic yards were excavated. Amount expended to June 30, 1867, $4,564 62; leaving available for fiscal year commencing July 1, $35,435 38.

In view of the commercial importance of this harbor, it is one of those deemed necessary to be enlarged to an increased depth of 15 feet, and a width of 300 feet. The officer in charge estimates for such improvement an additional cost of $470,000. Additional appropriation required for the next fiscal year, to carry out this plan, $150,000.

(See Appendix B.)

7. SURVEY AND IMPROVEMENT OF SANDUSKY RIVER, OHIO.

This survey has been made, and a report submitted for improving the navigation between Frémont and Sandusky bay, by dredging.

To make a channel from 160 to 200 feet wide, with a depth of 12 feet, will require the excavation of 185,075 cubic yards of sandy earth.

A contract was entered into, upon favorable terms, for the work, to the extent of the present appropriation of $20,000. At the prices of the contract, there will be required, to complete the dredging of this channel, an additional appropriation (which should be appropriated for the next fiscal year) of $35,000.

(See Appendix B, and B 19.)

8. SANDUSKY CITY HARBOR, OHIO.

A contract was entered into in October, 1866, for dredging upon the outer bar. The engineer in charge reports that the weather has not allowed dredging in that exposed place up to the expiration of the fiscal year, June 30. No further appropriation required until the effects of the dredging are known.

(See Appendix B.)

9. VERMILLION HARBOR, OHIO.

Contracts for materials and labor were entered into in October, 1866. Amount expended to end of fiscal year, June 30, 1867, $11,987 16; leaving a balance available July 1, 1867, of only $3,328 58.

A more critical examination than that made in the winter, upon which the estimates were based, disclosed that the old under-water work of the west pier was more damaged than it was at first supposed to be, and a cutting away of the shore which has taken place since a breach of 400 feet has been stopped, requires much work to secure the pier at that point from destruction. These items will add $6,511 to the cost of repair, which can be taken from the general fund for "repairs and preservation of lake harbors." No additional appropriation will therefore be required.

(See Appendix B, and B 20.)

10. HURON HARBOR, OHIO.

Contracts were entered into October 3, 1866, for materials and labor for the repair of both piers, and for rebuilding the cribs at the extremity of the east pier. The contractor having failed to furnish all the timber required, new proposals were advertised for, and a new contract made June 22, 1867. The percentage retained from the first contractor was more than sufficient to make good all loss to the work by his failure.

Amount expended to end of fiscal year June 30, 1867, $10,960 24; leaving available July 1, 1867, $28,039 76; less amount of repairs, as per contract, $25,070 15; leaving a balance of $13,929 85. No additional appropriation is therefore required.

(See Appendix B.)

11. BLACK RIVER HARBOR, OHIO.

The rebuilding of the outer extremity of the east pier has much improved the depth over the outer bar. In a year or two hence an expenditure of a few thousand dollars will probably be required for stopping such holes as may develop themselves in the old under-water work of the west pier.

The appropriation of $10,000, made in 1866, is still available for repairs. No additional appropriation required.

(See Appendix B.)

12. CLEVELAND HARBOR, OHIO.

The principal part of the east pier is still occupied by a railroad company. Nothing will be done towards its repair until vacated by them. The officer in charge reports that, in consequence of the use and abuse of this pier, it is fast going to pieces.

Contracts for the extension of both piers into the lake were made in October, 1866, both for material and labor.

During the fiscal year ending June 30, 1867, there was expended from the appropriation of 1866, principally for materials, $8,215. Amount available July 1, 1867, $51,590 45. Amount required to complete the present plan, $63,497. Additional amount required, $3,691. This harbor is one of those selected for an increased depth, that will admit vessels of 14 feet draught. The estimated cost of this improvement is $39,000. Additional appropriation required for the next fiscal year, $43,000.

(See Appendix B.)

13. GRAND RIVER HARBOR, OHIO.

The officer in charge was instructed to make an accurate survey of this harbor, in order that the question of improvement might be more fully discussed. In his report, transmitting the result of this survey, he recommended that the extension of the east pier should be made in a direction parallel to the flare of the west pier. This was not approved, and instructions were given for the extension of the pier in its present direction.

The work of extension was put under contract (for materials and labor) March 20, 1867. From this time to June 30, 1867, there has been expended, $3,143 02; leaving available July 1, 1867, $53,310 22. The cost of extending the east pier 320 feet, according to contract, with ten per cent. for contingencies, will be $21,631; leaving for dredging and further improvements, $33,040. No additional appropriation will be required for the next fiscal year.

(See Appendix B, B 21, and B 22.)

14. ASHTABULA HARBOR, OHIO.

Contracts were entered into for material and labor for the repair of both the old piers October 1, 1866.

The thorough repair of the old piers is estimated at	$11, 838 00
Amount expended up to 30th June, 1867	5, 944 03
Balance available July 1, 1867	72, 764 29

Proposals were invited in May for dredging, but owing to the terms of the only bid made it was not accepted. Some doubts as to the character of the material to be dredged led to the making of borings similar to those at Conneaut harbor. No contracts have been entered into; no additional appropriation required.

(See Appendix B.)

15. CONNEAUT HARBOR, OHIO.

Proposals were invited for dredging May 17, resulting in a very high bid, owing to doubts entertained by contractors as to the character of the bottom. Borings were therefore made to remove all doubt as to the nature of the bottom. These have shown the rock to be everywhere more than twelve feet below the low-water stage, and that the material to be dredged is sand. The above bid being unreasonably high for this material, new bids will be invited, at the same time advertising for materials and work for the extension of the west pier, as far as the amount available will admit.

Amount appropriated for this harbor in 1866 and 1867 for dredging and for repairing old works	$30, 513 00
Amount expended during the fiscal year ending June 30	3, 134 81
Additional appropriation required for the next fiscal year to extend the west pier into twelve feet water, and to complete the work to the extent and capacity planned	11, 000 00

(See Appendix B.)

16. ERIE HARBOR.

The amount appropriated for the harbor in 1866 and 1867 was..	$61,961 00
Considerable time was necessarily consumed in perfecting contracts before the work could be begun. Contracts were entered into on the 20th March, and from that time to 30th June there was expended	6,214 91
The cost of extending the north pier, (new work) including 10 per cent. for contingencies, is estimated at	34,339 00
Leaving available for dredging and other purposes	27,622 00

The dredging upon the outer bar was begun on the 16th April, and during the month 1,878 cubic yards were removed. But from that time to 30th June no more dredging was done, in order not to be in advance of the extension of the north pier. The work is progressing under the contracts.

A thorough examination of the old breakwater, from the south pier to shore, built many years ago, and of the old north and south piers, has resulted in an estimate from the officer in charge, for the complete repair of all the old harbor works, of $33,739, in addition to the amount already appropriated for the new improvement.

This harbor is one of those selected for an increased depth that will admit vessels of fourteen feet draught.

The estimated cost of this improvement is	$35,000 00
Total additional appropriation required for the next fiscal year to repair old piers and increase the depth of the channel for vessels of fourteen feet draught	69,000 00

(See Appendix B.)

17. HARBOR OF DUNKIRK, NEW YORK.

Contracts for the work on the west pier have been entered into and the work commenced.

Owing to the length of time required to collect materials not more than three hundred feet can be built this season.

Amount available for the harbor June 30	$100,000 00
Additional appropriation required for the next fiscal year	50,000 00

(See Appendices B, B 23, and B 24.)

18. BUFFALO HARBOR.

Colonel and Brevet Major General Cram has submitted a report and plan of improvement for this harbor in which he proposes:

1. To repair and protect the existing north and south piers.
2. To extend the south pier three hundred to six hundred feet.
3. To remove two hundred to four hundred feet of south end of Erie basin breakwater.
4. To construct a new breakwater in twenty-five feet water, about four thousand feet long and eight feet high, to shelter the harbor from prevailing winds, and to secure a larger space for refuge.
5. To ascertain, upon careful examination, the practicability of opening a ship channel from the lake at South Cut directly to Buffalo creek.

In order to obtain sufficient data to perfect this plan, numerous measurements and examinations into the condition of the existing piers were made, as well as lines of soundings and borings into the bed of the lake, to ascertain the depth of water and nature of the bottom upon which the proposed structures are to rest. These examinations have occupied Captain and Brevet Lieutenant Colonel Harwood, under the direction of General Cram, up to the end of the fiscal year.

These plans will be submitted to a board of engineers, and in the mean time the repairs and protection of the present north and south piers will be made, and the south pier will be extended three hundred feet, or as far as the present appropriation will admit.

The amount of funds available for this work on the 30th of June, 1867, was $200,000. No part of this appropriation has been expended up to this time.

(See Appendices B and B 25.)

19. SEA WALL AT BUFFALO.

Under the appropriations of 1864 and 1866 the late Major Tardy, corps of engineers, commenced operations upon the sea wall in October, 1864, and continued the construction until the close of the working season of 1866. The balance of appropriations remaining unexpended is $23,751 39. The further extension of this wall does not appear to be required at present.

(See Appendix B.)

IV.—*Harbors on Lakes Ontario and Champlain.*

Officer in charge, Brevet Colonel C. E. Blunt, lieutenant colonel corps of engineers, having under his orders Brevet Major C. J. Allen, captain corps of engineers.

1. IMPROVEMENT OF OLCOTT HARBOR, (EIGHTEEN-MILE CREEK,) NEW YORK.

Contracts for this object have been entered into. The plans proposed and approved, and which will be partially carried out with the amount now available, contemplate the construction of two parallel piers, 200 feet apart, and 1,000 feet each in length, and dredging to give ten feet of water.

The engineer in charge states in his report that the commencement of operations at this place, as well as at all other harbors on Lakes Ontario and Champlain, has been seriously delayed by the difficulties and obstacles arising from the provisions of the law, which, instead of facilitating the speedy and economical execution of the works for which appropriations have been made, have had precisely the opposite effect.

Amount appropriated at last session of Congress	$60, 000 00
Amount required for completion of work	118, 000 00
Amount required for next fiscal year	58, 000 00

(See Appendix C.)

2. IMPROVEMENT OF OAK ORCHARD HARBOR, NEW YORK.

Within the entrance of Oak Orchard creek there is a depth of eighteen feet, and piers constructed some years ago made a good harbor of refuge for vessels. These piers, being much decayed, require repair, and some dredging is needed of a bar which has formed since the injury to the piers occurred. Contracts for these objects have been entered into.

Amount appropriated at last session of Congress, $87,000. No further appropriation is deemed necessary.

(See Appendix C.)

3. IMPROVEMENT OF HARBOR AT CHARLOTTE, (MOUTH OF GENESEE RIVER,) NEW YORK.

The rebuilding of the west pier was continued during the fall of 1866, under partial contracts already reported. The completion of this reconstruction and of that of the east pier have been provided for by contracts made late in the present working season, by the close of which the work on the west pier will be finished, and, it is hoped, some progress made upon the east pier.

The last appropriation (in 1866) was supposed to be sufficient for all necessary improvements at this point; but the data furnished by the work already executed, and the terms of the contracts for the remaining work, render it probable that a small additional sum will be required.

Amount appropriated in 1866	$75, 607 80
Additional amount required for the next fiscal year	10, 000 00

(See Appendix C.)

4. SURVEY AND EXAMINATION AT PUTNEYVILLE, NEW YORK.

This was made in June, 1867. To *make* a harbor here (there being now none worthy of the name) will require the construction of two piers, 850 and 900 feet long, and 32,000 cubic yards of dredging, the cost of which is estimated at $87,000.

(See Appendix C.)

5. IMPROVEMENT OF BIG SODUS HARBOR, NEW YORK.

The work of rebuilding the west pier and dredging the channel, under contracts made and reported last year, was commenced late this working season, by the end of which it is expected that six hundred feet of pier will be rebuilt, and a channel eighty feet wide dredged to twelve feet at low water. A contract for dredging under the last appropriation has been made, and some work will be done under it this year. Contracts for the reconstruction of the remainder of the piers will be made in time for next season's work. It is thought that the sum now available will be sufficient to complete the necessary improvement.

Amount appropriated at last session of Congress, $80,000. No further appropriation is required.

(See Appendix C.)

6. IMPROVEMENT OF LITTLE SODUS HARBOR, NEW YORK.

The dredging of the channel and extension of the west pier, for which contracts were made and reported last year, have progressed during the season of 1867, at the end of which it is expected that four hundred and fifty feet of new pier will be finished, and a cut eighty feet wide, with twelve feet water, made in the channel. A contract has been made for dredging under the new appropriation, and work has been commenced. Contracts for the further extension of the pier will be made in time to resume the work next spring. A short east pier (about two hundred and fifty feet) is deemed advisable to define the channel; and the closure (by a cheap crib work) of the opening between the present pier and the west shore of the entrance is considered necessary.

A moderate appropriation is needed for these objects, which, when accomplished, will complete all that is necessary at this harbor until the decay of the part of the wooden piers above water requires their repair.

Amount appropriated at last session of Congress	$50,000 00
Additional amount required for completion of work	25,000 00
Amount required for next fiscal year	25,000 00

(See Appendix C.)

7. IMPROVEMENT OF OSWEGO HARBOR, NEW YORK.

The dredging of the harbor and repairs of the United States pier have been continued during the year, under contracts heretofore reported. The dredging so far executed has rendered available for vessels a part of the pier and west portion of the harbor. The revenue cutter will now be enabled to winter here, which has not been possible for some years. The dredging will be continued and can be nearly completed under a new contract already made. The pier will probably require an annual expenditure to maintain it in serviceable condition. For this repair and the completion of the dredging, an additional appropriation is asked.

Amount appropriated at last session of Congress................	$60,000 00
Amount required annually for United States pier..............	12,000 00
Amount required for next fiscal year for completion of dredging and maintenance of pier..	25,000 00

(See Appendix C.)

8. IMPROVEMENT OF OGDENSBURG HARBOR, NEW YORK.

The special board of engineers, of which Colonel and Brevet Brigadier General H. Bache was president, convened in June, 1867, for the purpose of considering the plans proposed for the improvement of this harbor, after full examination reported in favor of expending the whole appropriation in dredging. Their report has been approved, and a contract entered into under which some work is expected to be done this season.

The amount appropriated at the last session of Congress ($40,000) is sufficient for the work at this point, and no further sum is asked for.

(See Appendix C and C 1.)

9. IMPROVEMENT OF PLATTSBURG HARBOR, NEW YORK.

The repair of the breakwater above low water, decided upon last year, has been contracted for, and will probably be completed in 1867. The reconstructed work will be somewhat narrower than the old, and the cost will be rather less than the original estimate. The shoal, reported to exist as long ago as 1864, has been surveyed. A special report relating to it has been made to this office. This shoal should be removed, as it is a serious injury to the harbor. For this purpose an appropriation of $20,000 is required for the next fiscal year.

(See Appendix C and C 2.)

Improvement of Burlington harbor, Vermont—Extension of breakwater.

A special board of engineers, of which Colonel and Brevet Brigadier General H. Bache was president, recommended (in June, 1867) the extension of the present breakwater northward in a line parallel to the shore.

The extension (by crib work, ballasted with stone) should be 1,500 feet in length. Contracts for this work, as far as the available amount will permit, have been entered into, (in August,) and it is hoped something may be done this season.

Amounts appropriated at last and preceding sessions of Congress,	$107,672 20
Additional amount required for completion....................	225,769 80
Amount of appropriation required for next fiscal year.........	100,000 00

(See Appendix C and C 3.)

Increased depth of lake harbors.

In answer to an inquiry by the Committee on Commerce of the Senate, in relation to the increase of depth of harbors on the lakes to admit vessels drawing fourteen feet, a report was submitted to the Secretary of War on the 19th day of February, 1867, recommending certain harbors for such increased depth, and the estimated cost for the improvement. A copy of the report, accompanied by reports of each of the engineers in charge of the harbor works is herewith appended.

(See Appendix C 4.)

Surveys and improvement of the upper Mississippi, Minnesota, Wisconsin, and Fox rivers, &c.

Officer in charge, Major and Brevet Major General G K. Warren, corps of engineers, assisted by Captain and Brevet Major C. R. Suter, corps of engineers.

In May last, the engineer in charge, having completed his duties as a member of the board of engineers for considering the plan for the improvement of the Des Moines rapids of the Mississippi, was directed to proceed to St. Louis and Cincinnati for the purpose of examining steamboats with a view to procuring a suitable one for snagging and dredging on the upper Mississippi and Wisconsin rivers. Upon his return to St. Paul, in June, both of the above rivers were found to be too high for carrying on advantageously any portion of the surveys, &c., other than gauging; and this was immediately commenced.

Proposals were invited in June, first, for the sale of steamboats to the United States, to be used in dredging the sand-bars; second, for wrecking the steamer Northern Light; and, third, for removing snags and boulders from the Minnesota river, it having become obvious that nothing could be accomplished this season with boats to be constructed.

No results having been obtained from the invitation referred to, and other efforts proving unavailing, steamboats were subsequently purchased, and immediately put in preparation by attaching the requisite scrapers, &c., for the work designed for them.

A favorable contract was made for removing the obstructions from the Minnesota river; and the wreck of the Northern Light was removed by the wrecker belonging to the western river improvements, which was directed to perform the duty, having been sent to the upper Mississippi as a sanitary measure.

The surveys of the upper Mississippi and Wisconsin rivers have progressed satisfactorily, and the latter will be completed this season.

All of the works are being urged forward as rapidly as is consistent with accuracy and a due regard for economy.

The engineer in charge asks an appropriation of $50,000 for continuing the survey of the upper Mississippi, which has been included in the estimate for examination and surveys on western and northwestern rivers.

His estimate for continuing to operate two snag and scraper boats on the Mississippi river during the next fiscal year is $36,000.

He further recommends the construction on the Mississippi river of the dams at Prescott, at a cost of $5,000, and at Waconta chute, at a cost of $5,000; and on the Minnesota river of the dam and lock at Little Falls, at a cost of $60,000, as without this work the benefit to be derived from the removal of the snags and boulders, which is now going on, will be imperfectly realized.

The construction of the dam and lock at Meeker's island, on the Mississippi, at a cost of $235,665, is also recommended by him. The items for these constructions have not gone into the annual estimates from this office, since the works have not yet been approved by Congress.

(See Appendix D.)

Improvement of the Des Moines rapids, and of the Rock Island rapids of the Mississippi river—Survey of the Illinois river, and survey of the Rock river in Wisconsin and Illinois.

Officer in charge, Brevet Major General J. H. Wilson, lieutenant colonel thirty-fifth infantry, having under his orders Brevet Lieutenant Colonel P. C. Hains, captain corps of engineers.

1. IMPROVEMENT OF THE DES MOINES RAPIDS OF THE MISSISSIPPI RIVER.

A careful survey of these rapids was made during the autumn of 1866, the results of which, together with the details of the plan of improvement proposed by the officer in charge, were submitted from this office and transmitted to Congress February 6, 1867, and printed in House document No. 79, second session 30th Congress.

In this report the officer in charge recommended the construction of a lateral canal, extending along the Iowa shore, from Keokuk to the village of Nashville, a distance of seven and six-tenths miles, and that the improvement should be completed to Montrose, by making a through cut two hundred feet wide, and five or six feet deep, along the natural channel of the "upper chain." That the dimensions of the canal should be as follows: length seven and sixth-tenths miles; width on water surface, three hundred feet; depth at lowest stage, six feet, with two lift locks and one guard lock, each three hundred and fifty feet long, and eighty feet wide at top; and that the embankment should be made twenty feet wide on top, be carried up to four feet above the highest known flood, and be covered inside and outside and on the top with rip-rap of broken stone.

The appropriation of $500,000, by act of March 2, 1867, required that this amount should be expended according to such plan as the Secretary of War should, on the report of a board of engineers, approve. Accordingly, a board of engineers, composed of the following officers: Colonel J. N. Macomb, corps of engineers, president; Lieutenant Colonel and Brevet Major General J. H. Wilson, thirty-fifth infantry; Major and Brevet Major General G. K. Warren, corps of engineers; W. Milnor Roberts, esq, United States civil engineer, and Captain and Brevet Lieutenant Colonel P. C. Hains, corps of engineers, recorder, was convened at Keokuk, Iowa, April 16, 1867, which, after a careful consideration of the subject, recommended certain changes in the details of the above-mentioned plan, viz: that the embankment be reduced to ten feet in width on the top, with a riprap covering two feet thick, to be carried two feet above extreme high water instead of four feet; the prism of the canal to be three hundred feet wide in embankment, but reduced to two hundred and fifty feet in excavation; the minimum depth of water to be five feet, maximum depth eight feet.

These recommendations of the board were concurred in at this office, and approved by the Secretary of War, and the officer in charge directed to proceed at once to carry out the plan adopted. Accordingly a contract has been entered into after due advertisement for proposals for excavating the prism, and building the embankment of the canal. This part of the improvement was selected as the first to be commenced, for the reason that the embankment being, through most of its length, in the river, will require a more uncertain length of time for its completion, and be more liable to be delayed. After partial completion it will afford protection to the lock work from damage by high water or ice; and, also, for the reason that the $700,000 already appropriated will nearly complete the embankment, leaving the locks and the channel improvement at the "upper chain" to be provided for by future appropriations.

The officer in charge estimates that $1,500,000 will be required for the remainder of the work, and reports that the entire improvement can be economically completed by the 1st of November, 1869, provided the total sum required be appropriated at the next session of Congress.

(See Appendix E, E 1, E 2, E 3, and E 4.)

2. IMPROVEMENT OF THE ROCK ISLAND RAPIDS.

The act of March 2, 1867, appropriated $200,000, which, in addition to $100,000 already appropriated and still unexpended, gives $300,000 for the prosecution of the improvement.

The plan adopted is to excavate and straighten the natural channel, which will require about 58,000 cubic yards of rock excavation.

A contract has been entered into, the contractors being required to remove at least 5,000 cubic yards of rock per month. They are to use coffer-dams, chisels, or sub-aqueous blasting, as they may think best; but all tools, implements, machinery, boats, and materials of whatever character must be furnished at their own expense, the government paying only for the work done.

As yet but little has been accomplished, in consequence of continued high water. During the summer the chisels have been put to work on one of the upper reefs of Duck Creek "chain," and the contractors are building a coffer-dam, immediately below the point at which the chisels are working, for the purpose of cutting through the principal "chain" at that place.

The officer in charge estimates that $813,602, including the $300,000 already appropriated, will be required, under the plan adopted, for the entire and permanent completion of this improvement, and that $513,602 can be profitably expended during the next fiscal year. He asks that this sum be appropriated as soon as practicable, in order that advantage may be taken of every opportunity presented by low water in the river for doing the work, and he reports that the entire improvement can be completed by the 1st of November, 1869, if the necessary funds are provided.

(See Appendix E, E 5, E 6, and E 7.)

3. SURVEY OF THE ILLINOIS RIVER.

The act of June 23, 1866, authorized the survey of Illinois river from La Salle to its mouth. This was made during the autumn of 1866, and a report thereon, submitted from this office, transmitted to Congress and printed in Ex. Doc. No. 16, House of Representatives, fortieth Congress, first session.

As the operations of this survey were confined to that part of the country lying below La Salle, it was thought necessary to extend the survey to Lake Michigan before absolutely fixing upon the plans of improvement. Accordingly a detailed and exhaustive survey of the country between La Salle and Chicago, as well as a low-water survey of the river from La Salle to its mouth, have been undertaken, and are now satisfactorily progressing.

William Gooding, esq., civil engineer, and late chief engineer of the Illinois canal, was appointed (under the resolution of Congress in relation to surveys of western rivers) to co-operate with Brevet Major General Wilson in the execution of these surveys and examinations.

The plans will be submitted as soon as these surveys are finished.

4. SURVEY OF ROCK RIVER IN WISCONSIN AND ILLINOIS.

This survey, provided for by act of June 23, 1866, was made during the autumn of 1866, and a report thereon, with plans for a system of canal and slack-water navigation, submitted from this office, transmitted to Congress April 11, 1867, and printed in Ex. Doc. No. 15, House of Representatives, fortieth Congress, first session.

Improvement of the mouth of the Mississippi river; survey of Galveston harbor, Texas; and survey of Bayou Manchac and Amite river, Louisiana.

Officer in charge, Brevet Brigadier General M. D. McAlester, major corps of engineers, having under his orders First Lieutenants D. W. Payne and W. S. Stanton, corps of engineers, and First Lieutenant John K. Heslep, corps of engineers, since deceased.

1. IMPROVEMENT OF THE MOUTH OF THE MISSISSIPPI RIVER.

The contractor, who, according to contract, was to have formed a channel across the Southwest Pass, of eighteen feet depth and two hundred feet in width, by the 23d January, 1867, and maintain the same three months, failed to complete his dredge-boat before the latter part of March, 1867, when he commenced work. The time for completing the formation of the channel was, on his application, repeatedly extended till the latter part of May, 1867, when it appearing that owing to the inadequate and imperfect character of his boat and machinery he was likely to accomplish no result, his contract was annulled.

Surveys of the Southwest Pass and Pass à Loutre were made during the spring months of the year, with the assistance of two parties of the United States Coast Survey, kindly detailed for the purpose by the superintendent. The examinations consisted mainly in ascertaining the soundings, the extent of the bars along the mid-channel line, and the character of the surfaces and sub-strata of the bars.

The officer in charge of this improvement has perfected models, drawings, and specifications of a dredge-boat authorized by the joint resolution of Congress approved March 29, 1867, and has advertised for proposals for constructing and delivering the same.

Pass à Loutre has been selected for improvement under the appropriation for the current fiscal year, which, added to the unexpended balance on hand, amounts to about $273,000.

The plan adopted is that of excavating and stirring up the minute alluvial material by means of double-ender dredge-boats fitted with an excavating screw and an auxiliary scraper. The light material thus again brought into a floating condition will be gradually carried off to deep soundings by the current of the river and tide of the Gulf. Owing to the condition under which the bars are formed and maintained, this work is not susceptible of "entire and permanent completion." After the completion of the two dredge-boats required for the work, an annual expenditure of $100,000 will be required for the constant maintenance of a twenty-feet channel.

During the next fiscal year $375,000 can be profitably expended upon the work, and is absolutely essential to its success, of which $100,000 is estimated for running expenses, repairs, &c., and $275,000 for construction and delivery of the second of the two required dredge-boats.

(See Appendix F, F 1, and F 2)

2. SURVEY OF GALVESTON HARBOR WITH A VIEW TO ITS PRESERVATION AND IMPROVEMENT.

The Superintendent of the Coast Survey kindly ordered one of its parties for the execution of the survey under the direction of the engineer officer in charge. The survey was begun in June, and assiduously continued until the breaking out of sickness, when the party was discharged.

The survey will be resumed as soon as the subsidence of the yellow fever will permit.

3. SURVEY OF PASS AND BAYOU MANCHAC, AND OF AMITE RIVER, TO ASCERTAIN THE PRACTICABILITY OF STEAMBOAT NAVIGATION BETWEEN THE MISSISSIPPI RIVER AND LAKE PONTCHARTRAIN.

The field-work of the survey was begun and completed by First Lieutenant J. K. Heslep, corps of engineers, since deceased.

The reports and accompanying maps will be submitted at an early day.

(See Appendix F.)

1. *Survey for a ship canal around the falls of the Ohio.*

Brevet Major General G. Weitzel, major corps of engineers, was placed in charge of this improvement May 11, 1867, with instructions to make a special report upon the same at the earliest day practicable.

The survey has been diligently prosecuted, and is still in progress. It will probably be completed, and the report submitted by the 1st of February next.

2. *Survey of Tennessee river.*

This survey is also progressing satisfactorily. As soon as completed the results will be made the subject of a special report.

Improvement of the western rivers, excepting the Ohio river.

Officer in charge, Colonel J. N. Macomb, corps of engineers, brevet colonel United States army, having under his orders Brevet Major C. W. Howell, captain corps of engineers.

The work upon these improvements has thus far been principally of a preparatory character. Three double-hulled snag-boats have been contracted for, and only await a rise of water to be launched. They embrace several important improvements upon the plan of those formerly in use, and hopes are entertained of their being very efficient. Should they meet these expectations and show the superiority of the machinery provided for them, an additional number will probably be built.

Amount of funds made subject to the requisition of the engineer in charge on commencing this work, (under appropriation of 23d of June, 1866)	$400,000 00
Amount that will probably be expended by the 30th June, 1868.	325,000 00
Leaving available on the 1st July, 1868	75,000 00

which the engineer in charge recommends should be reserved as a construction fund in case experience should call for any important additions to the new boats or their machinery for removing snags.

Examination and surveys on western and northwestern rivers.

An examination was made of the Arkansas river in the winter of 1866–'67, and one is now in progress on the Missouri river.

Amount of funds under this head (from the appropriation of 23d June, 1866) made subject to the requisitions of the engineer in charge of the western river improvements, as above	$20,000 00
Amount probably to be expended by 30th June, 1868	11,875 00
Leaving as available on 1st July, 1868	8,125 00
Amount probably required for the fiscal year ending on the 30th June, 1869	$30,000 00
From which deduct amount probably available	8,125 00
Leaving amount to be appropriated to fill the estimate under head of "examinations and surveys of western and northwestern rivers," for the fiscal year ending 30th June, 1869	21,875 00

to be allotted to the engineer in charge of western river improvements, as above.

Improving the Mississippi, Missouri, and Arkansas rivers.

Under this head a wrecking boat has been purchased and fitted for the service of blowing up wrecks encumbering the channels, and has thus far been employed upon the Mississippi in working at wrecks near St. Louis and near Memphis; but the water proving to be too high, it was found necessary to defer the finishing work upon those wrecks until the recurrence of a low stage of water.

Whilst employed as above the crew of the wrecking steamer were instrumental in saving life from the wreck of the sinking steamer Gov. Sharkey.

The wreck of the steamer Northern Light, in Coon slough, of the upper Mississippi, is reported as removed, so as to leave nothing of it remaining within thirteen feet of the water surface at low water.

Contracts have been made with parties to work at the removal of snags and other such obstructions to the navigation of the upper waters of the Arkansas and Missouri rivers, and one of the large snag-boats will probably be worked in the lower waters of each of those rivers as soon as possible.

Amount made subject to the requisitions of the engineer in charge.	$366, 666	00
Total probable expenditures under this head of appropriation to end of fiscal year ending on 30th June, 1868..............	255, 110	00
Leaving available on 1st July, 1868	111, 556	00

Estimate for fiscal year ending on the 30th of June, 1869......	$396, 000	00
Deduct amount that will probably remain on hand as above....	111, 556	00
Showing that there will be required to be appropriated under this head of "Improvement of the Mississippi, Missouri, and Arkansas rivers," for the fiscal year ending on the 30th of June, 1869, the sum of....................................	284, 444	00

(See Appendix H, H 1, and H 2.)

Ohio river improvement.

Engineer in charge, W. Milnor Roberts, United States civil engineer, who was also a member of the board of engineers on the improvement of the Des Moines rapids of the Mississippi river.

Two surveying parties are engaged upon the river, one in surveying between Gallipolis and Cincinnati, a distance of about 200 miles; another between Cincinnati and Louisville, about 145 miles. Upon the completion of these surveys the parties, should the season permit, will proceed with the surveys between Louisville and Cairo. The object of these surveys is to gather the necessary detailed information respecting the pools, ripples, shoals, islands, &c., and to prepare reliable maps of the same for use in the execution of the projects of improvement.

Estimated cost of the necessary examinations and surveys of the Ohio river to the end of the fiscal year June 30, 1868........	$22, 000	00
Of which there was expended to June 30, 1867..............	6, 677	18
Leaving to be expended during the fiscal year ending June 30, '68.	15, 322	00
Additional amount required for next fiscal year ending June 30, 1869...	10, 000	00

Contracts have been entered into for the delivery and putting in place of stone at the following riprap dams, viz: White's ripple, Logtown bar, Twin island, Captina island, Fish creek, Petticoat bar, Muskingum island, Blennerhasset's island, and Buffington island. It is expected that these dams will be completed before the 1st of December, 1867. Some of the dams are advanced far enough to cause a marked improvement in the depth of water in the channels.

A contract has been made and the work commenced for removing river obstructions, such as snags, wrecks, &c., at a fixed price per day, the contractor furnishing vessels, tools, men, &c., at his expense. This plan, which was to some extent experimental, has, on the upper Ohio, so far proved successful and advantageous to the government.

The engineer in charge estimates the cost of one steamer, &c., for a full season of seven months' work at $17,017; and estimates the total cost of removing obstructions from the whole length of the river, as follows:

Estimated expense of one boat, &c., during the season of 1867..	$14,000 00
Estimated expense of two others, for two months, in 1867......	9,724 00
Estimated expense of three boats during the season of 1868, at $17,017 each..	51,051 00
Total from the beginning of 1867....................	74,775 00

The known obstructions in the river, as reported in October, 1866, consisted of snags and snaggy places, 90; logs and loggy places, 66; wrecks, 46; sunken boats, barges, &c., 83; making a total of 285.

It is considered important that adequate appropriations should be made for continuing the present general system of improvement, which is, in brief, the construction of proper wing-dams, the excavation of portions of certain bars, the removal of rocks and numerous other obstructions, a detailed statement respecting which will be found in the report of the superintending engineer—(Appendix I.) He states that although accurate detailed estimates as to the necessary expenditure at particular points cannot as yet be made, approximate estimates may be made of the probable cost of perfecting such works as are likely to be necessary; that above Louisville, and especially above Cincinnati, a nearer approach can be made to accuracy than at points below, owing to the difference in the regimen of the river; that below Louisville, the question is complicated by the river being much wider, the fall and current much less, and by the formation of extensive moving sand shoals, the perfect control of which has not yet been attained.

The sum apportioned to the improvement of the Ohio river from the appropriations of 1866 and 1867, is.............................. $272,000 00

The superintending engineer estimates the cost of completing the present system of improvement, in addition to former appropriations, to be—

Between Pittsburg and Louisville...........................	$473,000 00
Between Louisville and Cairo..............................	363,000 00
	836,000 00

And states that, in his opinion, should the season prove favorable, the whole work estimated for can be finished by the end of the season of 1868, provided the appropriation be made in time to admit of his entering into contracts by the 1st of April.

In view of the fact that no plans have yet been presented by the engineer in charge for the works below Louisville, excepting at one or two points, and that the improvement of that portion of the river is a very difficult problem, and, further, that some of the works above Louisville are contingent in their character, the whole amount of his estimate for the Ohio river cannot at this time be approved. It is recommended that there be appropriated for the next fiscal year the sum of $500,000.

(See Appendix I.)

Improvement of the Patapsco below Fort McHenry, and of the Susquehanna below Havre de Grace.

Officer in charge, Brevet Lieutenant Colonel W. P. Craighill, major corps of engineers.

1. IMPROVEMENT OF THE PATAPSCO RIVER BELOW FORT M'HENRY.

A resurvey was made of the Brewerton channel and of the space east and south of Seven-feet knoll to the Belvidere shoal.

This survey was made by a Coast Survey party, the expense being borne by the appropriation for "examinations and surveys on the Atlantic coast."

From the close of the last fiscal year to the close of the working season of 1866, two dredges were worked in the Brewerton channel below North Point, where it was found to have filled up to some extent.

It has been decided to dredge a channel two hundred feet wide to a depth of twenty-two feet at mean low water, adhering to the direction of the Brewerton channel until a point is reached nearly opposite the Seven-feet knoll, and then adopting a direction almost due south to the deep water of the bay.

The dredges and scows belonging to the government required very extensive repairs. These were nearly completed June 30. Since that time the dredging has been successfully prosecuted.

Amount expended during the year ending June 30, 1867	$34, 682 88
Amount available July 1, 1867	55, 793 27
To be expended up to June 30, 1868	55, 793 27
Appropriation required for year ending June 30, 1869	125, 000 00

(See Appendix K.)

2. IMPROVEMENT OF THE NAVIGATION OF THE SUSQUEHANNA RIVER BELOW HAVRE DE GRACE.

A resurvey has been made of the portion of this river between Spesutie island and the railroad bridge near Havre de Grace. The survey was made by a Coast Survey party, the expense being borne by the appropriation for "examinations and surveys on the Atlantic coast."

It has been decided to dredge a channel of eight feet in depth and one hundred feet in width nearly in the direction of the channel dredged some years ago. This channel had filled up to a great extent, and would doubtless fill up again if no other method of improvement than dredging were used. It has been determined, however, to construct a floating deflector, with the view of throwing an increased volume of water through the channel, and thereby obtaining a greater depth of water and greater permanence of condition in the channel.

Should the effect of this floating jettee prove to be as advantageous as it is anticipated, it should be replaced by a permanent structure of stone. The depth of the channel should also be increased by dredging to ten feet.

The dredging and construction are going on.

Amount available July 1, 1867	$26, 400 00
To be expended during the year ending June 30, 1868	26, 400 00
For dredging to ten feet depth and making the deflector permanent an appropriation will be required for the year ending June 30, 1869, of	50, 000 00

(See Appendix K 1.)

Construction of Delaware breakwater, improvement of harbor of Marcus Hook and Chester harbor, and surveys of Reedy island and Liston Tree Point, in Delaware bay and river.

Officer in charge, Lieutenant Colonel C. S. Stewart, corps of engineers.

1. DELAWARE BREAKWATER.

Contracts have been entered into and work begun for the completion of the superstructure. About 1,200 tons of stone have been put in position, and the superstructure raised thereby to its full height for a length of 115 feet, leaving about 560 feet in length of the breakwater proper to be completed.

No work has been done on the ice-breaker.

The existing appropriation will probably be sufficient to complete the works on their present basis.

(See Appendix L and L 1.)

2. HARBOR OF MARCUS HOOK, PENNSYLVANIA.

Contracts were entered into during the year for the repair of the old piers, wharves, and landings, and others have been made since for the construction of new piers for the improvement of the harbor. No work had been done at the close of the fiscal year, June, 1867, but it is now in progress.

The present appropriation will probably be sufficient to complete the work. (See Appendix L and L 2.)

3. IMPROVEMENT OF CHESTER HARBOR, PENNSYLVANIA.

Proposals were invited and received, and contracts were in course of preparation for making the necessary repairs as soon as practicable after the 30th of June, 1867. The work is now in progress.

The present appropriation will probably suffice for the completion of the work. (See Appendix L and L 3.)

4. THE SURVEY OF REEDY ISLAND

Has been completed. The report has not yet been received.

(See Appendix L 4.)

5. THE SURVEY AT LISTON TREE POINT.

Will be completed in November, and the report will be transmitted as soon as received.

(See Appendix L 5.)

Hudson river improvement.—Repairs of United States dikes above and below Albany.—Commencement of re-survey of the river, with tidal observations and velocities of currents.

Officer in charge, Lieutenant Colonel and Brevet Major General John Newton, corps of engineers, assisted by Brevet Lieutenant Colonel John M. Wilson, major of engineers.

The United States dikes above and below Albany having been found upon examination to require extensive repairs, it was decided to expend the appropriation of 1866, together with the balance remaining from the allotment of 1864, amounting in all to $83,000, upon these repairs; and notwithstanding the lateness of the season at which work was commenced, and the unusual number of freshets which postponed active operations, considerable progress has been made.

A further appropriation of $305,108 was made by act of Congress, approved March 2, 1867, and before deciding upon the parts of the plan of improvement upon which it should be expended and the order of their execution, a board of engineers, Colonel and Brevet Brigadier General Hartman Bache president, was convened in Albany, in May last, to consider the project proposed by Brevet Major General John Newton, lieutenant colonel of engineers, the officer in charge, which was described in the report of the Chief of Engineers of January 26, 1867.

The board concurred in the views of General Newton, and recommended that the money should be distributed throughout the entire distance from New Baltimore to Troy, in such a manner as to meet the most pressing needs of navigation, beginning at the New Baltimore section.

The report of the board was approved, and the engineer in charge was directed to carry out its views.

A survey of the river near New Baltimore, and also at Cuyler's island above Albany, was made in May and June, for the object of locating correctly the works of improvement at those localities.

Tidal and current observations have also been taken. A survey of all that portion of the river which is to be improved is in progress.

Amount required for next fiscal year, $152,000.

(See Appendix M and M 1.)

Examinations at Hell Gate.

Examinations were made of Hell Gate, and a report and estimates for improving the navigation transmitted to Congress February 12, 1867, and printed in Ex. Doc. No. 91, House of Representatives, 39th Congress, second session.

Improvement of Westport harbor, Connecticut, Thames, Providence, and Pawtucket rivers, removal of Middle rock, New Haven, and survey of Rock island.

Officer in charge, Major and Brevet Colonel D. C. Houston, corps of engineers.

1. WESTPORT HARBOR, CONNECTICUT.

The original appropriation for this harbor, $2,500, is entirely inadequate to making the necessary improvement, which should consist of the repairs of the breakwater, Cedar Point, the repair of the walls of the canal leading from the habor to the sound, and the excavation of the bed of the canal, together with the removal of the obstructions in the channel of the river.

With the funds at present available the only work that can be done to advantage is the repair of the breakwater and of the walls of the canal, which will be prosecuted this fall as far as the appropriation will permit.

The amount required for the improvement of the harbor, in addition to the sum already appropriated, and which is required for the next fiscal year, is $10,000.

(See Appendix N.)

2. REMOVAL OF MIDDLE ROCK, NEW HAVEN, CONNECTICUT.

The work of removing this rock, which was commenced on the 13th of July, 1867, is progressing rapidly and satisfactorily. Some attempts had previously been made to blow off the top of the rock by exploding powder placed on it. This, however, failed, probably for the reason that there was not sufficient depth of water. Since then, holes have been drilled, cartridges of powder introduced; and exploded by means of a battery, with great success. On commencing operations this year the depth on the rock at low water was only nine feet. By the 1st of September five feet of the rock had been removed, giving fourteen feet at low water.

To secure a depth of seventeen feet at low water on this rock, as originally proposed, an appropriation will be required for the next fiscal year of $30,000.

(See Appendix N.)

3. IMPROVEMENT OF CONNECTICUT RIVER.

A survey of this river with a view to its improvement is now in progress, having been commenced on the 10th of August. Sufficient progress in the examination has not yet been made to enable a determination as to the precise nature of the works that will be necessary. When the survey is completed, and the plans and estimates prepared, the report will be submitted.

(See Appendix N.)

4. IMPROVEMENT OF THAMES RIVER, CONNECTICUT.

The work of deepening the channel of this river for a distance of about three miles below the city of Norwich, to obtain a depth of fourteen feet at high water, necessitated a preliminary survey, which was completed late in 1866. Since June, 1867, dredging has been prosecuted as rapidly as possible, and up to the present month, September, 14,820 cubic yards of material, mostly sand, have been excavated and removed from the channel and deposited in localities carefully selected, that it may not find its way back again to the channel. This river is subject to great freshets in the early spring, at which time quantities of ice come down from the inland water-courses of which the Thames is the outlet to Long Island sound. For this reason it is deemed best not to attempt to complete the work this year, in order that the effect of the freshets may be observed and the work so directed as to prevent the channel being injured in the future. The work is now progressing satisfactorily.

It is believed that the amount appropriated for the improvement of this river will suffice.

(See Appendix N.)

5. IMPROVEMENT OF PROVIDENCE RIVER, RHODE ISLAND; PAWTUCKET BAR, AND AT THE "CROOK."

The work during the year, in this river, consisted in dredging the channel at the "Crook," and raising and removing from the channel the wreck of a sunken schooner. This latter was successfully done, and the wreck deposited in seven feet of water at low water, and entirely out of the way of navigation.

The dredging consisted in deepening and widening the channel at the "Crook." Up to the 1st of September, 42,219 cubic yards of material, chiefly mud, had been removed, which, it is believed, will be all that is required to render free navigation practicable.

The disbursements made under the appropriations for this work up to the 1st of September, 1867, amount to $23,012 94. Amount available September 1, 1867, $1,987 06.

It is believed that no farther work at this point is necessary.

(See Appendix N.)

6. IMPROVEMENT OF PAWTUCKET RIVER, RHODE ISLAND.

The work during the year in this river consisted in dredging the channel to obtain a depth of six feet at low water. The material excavated so far, 12,430 cubic yards, is fine sand, and has been deposited on flats on either side of the channel. After the channel is once thoroughly opened, the constant passage of vessels in tow of steam tugs will tend to keep it open, and the improvement may thus prove to be permanent.

The disbursements made under the appropriation for this work up to the 1st day of September, 1867, amount to $4,409; amount available September 1, 1867, $12,591.

It is believed the amount already appropriated for this river will suffice.

(See Appendix N.)

7. SURVEY OF BLOCK ISLAND, RHODE ISLAND.

A survey of this island, with a view to the construction of a breakwater to form an artificial harbor, was commenced on the 19th of July, and has just been completed. The report will be submitted as soon as prepared.

Colonel Houston states that there appears to be no question that a harbor of refuge should be provided at this point, not only for the benefit of the immense fleet of mercantile marine that traverse Long Island sound and this part of our Atlantic coast, but also for our navy at any time, in peace or war.

(See Appendix N.)

Plymouth beach, and examination of Duxbury beach, Massachusetts.

Officer in charge, Captain and Brevet Major J. A. Smith, corps of engineers

1. PLYMOUTH BEACH, MASSACHUSETTS.

One thousand three hundred lineal feet of breakwater have been built. It consists of triangular frames placed at intervals of four feet, covered with two-inch plank, set in a trench twelve feet wide and three feet deep, the trench and frame being filled to the level of the ground. It is situated on the crest of a ridge of sand of about three miles in extent, and of an average width of 800 feet. At intervals along this ridge there are depressions through which the sea breaks with great violence. It is in these intervals that the breakwater is placed.

The engineer in charge believes that further improvements will be needed, principally cross-jettees, to arrest the sand in its motion along the beach, but has not submitted a plan or estimate for this.

Amount expended during the fiscal year	$8, 188 89
Balance on hand July 1	111 11

2. EXAMINATION OF DUXBURY BEACH.

The engineer in charge reports as the result of his examination of this locality that several depressions occur in the beach, of an aggregate length of 1,500 feet. But 500 feet, however, require repairs.

He submits an estimate for these repairs of $4,000, but is of the opinion that neither the value of the harbor nor the fear of immediate injury to the beach are sufficient to justify a recommendation of the appropriation.

(See Appendix O.)

Provincetown harbor and sea-walls at Great Brewster, Deer, and Lovell's islands, Boston harbor.

Officer in charge, Colonel and Brevet Major General H. W. Benham, corps of engineers. Brevet Major George Burroughs, captain corps of engineers, assistant.

1. PROVINCETOWN HARBOR, MASSACHUSETTS.

A new plank-fence bulkhead, about 700 feet long, with the necessary jettees, has been constructed for the protection of the shore and battery, about one-third of a mile south west from Long Point, the extremity of the cape. During the autumn of 1866 the old bulkhead adjacent to the light house was repaired. A contract has been made for the restoration of the bulkhead to the extent of 600 or 700 feet, and for a rough stone breakwater, to be completed during the present season.

At the outer sea beach, east of East harbor, the necessary catch-sands and about ten acres of beach grass have been planted, giving all the protection which thus far appears to be necessary.

At Beach Point peninsula a plank-fence bulkhead was constructed in the autumn of 1866, one third of a mile from the bridge, about 1,250 feet long, with the necessary jettees. This, though seriously injured by the storms of winter, has for the most part remained in position.

During the past year the inlet of East harbor, at the extremity of Beach Point, has filled up to a great extent by natural causes, and it appears to be probable that little if any expenditure will be required for closing it by artificial means.

No further appropriation required for the present.

(See Appendix P.)

2. SEA WALLS OF GREAT BREWSTER ISLAND, BOSTON HARBOR.

As soon as the appropriation for the past fiscal year was available the work was resumed, and was continued during the present season. It is expected that at its close all the main sea-wall as originally planned will be completed, which, in the judgment of the engineer in charge, will give ample protection to all the bluffs of the island.

The continued wearing action of the sea upon the beach between the two main walls render it necessary to connect them, at an expense, as estimated by the engineer in charge, of $34,000, which appropriation is asked for the next fiscal year. (See Appendix P 1.)

3. DEER AND LOVELL'S ISLANDS, BOSTON HARBOR.

The rebuilding of the wall of the Middle bluff in Deer island was commenced in August, 1866, and by the close of the fiscal year, June 30, 1867, 340 lineal feet of the dry wall were securely rebuilt with mortar joints and concrete backing, with a paving of heavy flat stones 12 to 15 feet in rear of coping. The wall is about 17½ feet high, with an average thickness of 8 feet.

It is expected that the remaining portions of the wall requiring relaying in Middle Head and South Head will be rebuilt during the present season.

At Lovell's island nothing has been done but the perfecting of contracts for facing stone for a wall at Southeast Head and for jettee stone for the old wall. It is expected that all the necessary stone will be delivered this autumn, and the work will be commenced as soon as the season permits in 1868.

Amount available for both works July 1, 1867	$84,529 30
Additional appropriation required for the next fiscal year	36,000 00

(See Appendix P 1.)

Preservation and improvement of Boston harbor, Boston, Massachusetts.

Officer in charge, Lieutenant Colonel and Brevet Major General J. G. Foster, corps of engineers.

The short time before the close of the fiscal year was occupied in making preliminary surveys, in advertising for proposals for dredging a channel across the Upper Middle bar, the removal by dredging of the southwest extremity of Lovell's island, and the extremity of Great Brewster Spit, and for blasting and removing the rocks in the Narrows (Tower Rock and Corwin Rock) lying between Fort Warren and the Narrows light, upon the extremity of Great Brewster Spit.

It is proposed during the present fiscal year to remove by dredging forty thousand cubic yards of material from the Upper Middle bar, so as to render the channel across it twenty-three feet deep at mean low water, with a width of about three hundred feet; to remove by dredging one hundred and forty-five thousand cubic yards from the southwestern point of Lovell's island and the extremity of Great Brewster Spit, so as to widen the main ship channel at that point from three hundred and sixty-five feet, its present width, to about five hundred feet, with a depth of twenty-three feet at mean low water; to remove entirely Tower Rock, by blasting, to twenty-three feet at mean low water, and to remove by blasting as much of Corwin Rock as the portion of the appropriation assigned to that object will admit; to commence the construction of the sea-walls at Long Island Head and on the north side of Gallup's island, and to commence the construction of the sea-wall to protect Point Allerton.

The work of dredging and blasting is now being successfully prosecuted Tower Rock has been removed.

Amount of appropriation required for the next fiscal year, viz:

Additional for the removal of Corwin Rock	$24,000 00
Dredging Great Brewster and Lovell's Islands Spits	60,000 00
Dredging Upper Middle bar	50,000 00
Preservation of North Head of Long island	75,000 00
Preservation of Gallup's island	54,000 00
Preservation of Point Allerton	21,000 00
Total amount required	284,000 00

(See Appendix Q and Q 1.)

Improvement of rivers and harbors in the State of Maine.

Officer in charge Brevet Brigadier General George Thom, lieutenant colonel corps of engineers.

1. IMPROVEMENT OF SACO RIVER.

A board of engineers, of which Colonel and Brevet Brigadier General Hartman Bache was president, was directed to report upon the proper position and extent of a breakwater at the mouth of the Saco river. The board recommended the plan of Brevet Brigadier General Alexander, to the extent and in the position he proposed. This was approved by the department, and contracts have been entered into for rough stone for the breakwater, and for the removal of some sunken rocks.

Estimated cost of the breakwater, with an additional coping on the exterior face, and other improvements in Saco river already reported upon	$270,000 00
Total amount appropriated in 1866 and 1867	80,000 00
Amount still required	150,000 00
Of which there can be profitably expended durig the next fiscal year	75,000 00

(See Appendix R and R 1.)

2. SURVEY OF RICHMOND ISLAND, CAPE ELIZABETH.

A survey of this locality has been made with a view to forming an estimate of the probable cost of a breakwater to connect the island with the main land. Such a breakwater would form a good harbor of refuge, affording safe anchorage and good holding-ground with the wind from any point between north and southwest, affording refuge to vessels prevented by northeast storms from entering Portland or adjacent harbors.

The breakwater, to be permanent, should be built of rubble stone, of which the engineer in charge estimates there will be required 68,000 tons. This, when placed in the structure, would cost $93,000. Amount which can be profitably expended during the next fiscal year, $50,000.

(See Appendix R 2.)

3. PORTLAND BREAKWATER.

A board of engineers, of which Colonel and Brevet Brigadier General Hartman Bache was president, was convened to investigate the question of the proper direction and length for the extension of the breakwater. The board recommended the adoption of the plan proposed by Brevet Brigadier General Alexander, corps of engineers.

Final action upon this project has not yet been taken. In the meantime, the repairs upon the present breakwater, and the completion of its unfinished portions, are in progress.

Contracts have been entered into, and it is probable that these will be completed during the next fiscal year.

The amount appropriated is deemed sufficient.

(See Appendix R 3 and R 4.)

4. SURVEY OF THE KENNEBEC RIVER ABOVE GARDINER.

The survey between Augusta and Shepard's Point was completed, and plans and estimates for the improvement of the river were submitted to Congress, and an appropriation for the purpose was made in the act of March 2, 1867.

Since that time the examination has been extended below Shepard's Point as far as Gardiner, which shows that some small amount of dredging is required on two shoals known as Hinckley's and Brown's Island shoals, and that a sunken rock in the channel must be removed. For these purposes an appropriation will be required of $3,000.

(See Appendix R 5.)

5. IMPROVEMENT OF THE KENNEBEC RIVER BETWEEN SHEPARD'S POINT AND AUGUSTA.

This work consists in straightening and deepening, by dredging, the channel of the river through several shoals.

The plan adopted will secure a channel through these shoals of a width of seventy-five feet at bottom, and a depth of eight feet at lowest water up to Hallowell, and seven feet thence to Augusta.

A contract for dredging has been entered into, and it is believed that the work will be finished during the fiscal year terminating June 30, 1868. The amount already appropriated is deemed sufficient.

(See Appendix R 6, R 7, and R 8.)

6. SURVEY OF THE "GUT" OPPOSITE THE CITY OF BATH.

Owing to the contraction of the channel of Back river at the upper Hell Gate, the tidal current runs through this gate with such violence as to endanger the navigation at any other time than at high and low water, except for steamers. The difficulties are still further increased by a large rock known as Boiler rock, which lies in mid-channel some seventy-five yards below the gate.

The engineer in charge examined this rock with the aid of a submarine party. It lies in from three to four fathoms of water at low water, its highest point being only about three feet below the surface at mean low water, and ten feet below at high water.

For the improvement of the navigation at this place, the engineer in charge recommends—

1. Boiler Rock to be removed to a depth of 12 feet, requiring 70 cubic yards of blasting, which, at $50 per cubic yard, would cost	$3,500 00
2. The point of ledge contracting the channel at upper Hell Gate to be blasted off, requiring about 1,500 cubic yards, at $4	6,000 00
3. Deepening the bar about midway between upper Hell Gate and Arrowsic bridge, so as to afford a channel 100 feet wide and 10 feet deep at mean low water, requiring 11,000 cubic yards dredging, which, at 50 cents per cubic yard, would cost	5,500 00
Add ten per cent. for contingencies	1,500 00
Total required for the proposed improvement	16,500 00

All of which could be profitably expended during the next fiscal year.

(See Appendix R 9.)

7. SURVEY OF THE PENOBSCOT RIVER ABOVE HAMPDEN.

This survey is progressing and will be completed during the present fall. No report in relation to it has as yet been received from the officer in charge.

8. SURVEY OF UNION RIVER.

A careful examination of this river from its mouth to Ellsworth has been made. The engineer in charge estimates that for the improvement of the navigation between these points by clearing it of slabs, edgings, and saw-dust, removing boulders and sunken rocks, and erecting five stone beacons, there will be required an appropriation of $40,000, which, in view of the large lumber trade, he recommends to be made.

Some legislation appears to be necessary, in addition to the local laws of Maine, for the protection of this and other navigable waters from obstructions caused by deposits of the refuse matter from these saw-mills.

(See Appendix R 10.)

9. IMPROVEMENT OF THE NAVIGATION OF THE ST. CROIX ABOVE THE LEDGE.

An examination of this river from the ledge to head of navigation, above Calais, a distance of about four miles, shows that the improvement of its navigation requires its channel to be deepened by the removal of slabs, edgings, and saw-dust, which for thirty years or more have been accumulating in large quantities from the numerous saw-mills above and near Calais.

The act of Congress making appropriation for this improvement requires the co-operation of the province of New Brunswick. The subject was brought to the notice of the British minister to the United States through the Department of State.

(See Appendix R 11.)

Rivers and harbors on the Pacific coast.

Officer in charge, Brevet Lieutenant Colonel R. S. Williamson, major corps of engineers, who has under his orders Lieutenant W. H. Heuer, corps of engineers.

1. IMPROVEMENT OF WILLAMETTE RIVER BELOW THE CITY OF PORTLAND, OREGON.

It was not practicable to do any work upon this river during the winter and spring.

The city of Portland has, during the two past years, done some dredging with the view of deepening the channel of the river, and has provided suitable dredging and other apparatus.

When proposals were invited for doing this work by contract, the city was the only bidder for removing Swan Island bar, at a price exceeding the amount of appropriation available, and as the act of Congress requires the work to be done by contract if possible, proposals were again invited, but no bidders presented themselves. It became necessary, therefore, to do the work with hired labor, and an arrangement was made with the city authorities of Portland to use their machinery free of charge, provided the United States kept it repaired.

At the date of the last report from the engineer in charge, August 5th, he was about to commence work, the state of the river not having admitted it previous to that time.

There is no data to estimate with certainty the amount required for the completion of this improvement, as there had been no work actually done at the date of the last report. The engineer in charge, however, estimates it roughly at $25,000, in addition to the amount now on hand.

Amount appropriated by act of March 2, 1867	$30,000 00
Amount expended during the fiscal year	871 49
Additional appropriation required for the next fiscal year	25,000 00

(See Appendix S.)

2. SURVEYS AND EXAMINATIONS ON THE PACIFIC COAST.

The acts of June 23, 1866, and March 2, 1867, directed the following surveys to be made:

1. Survey of Blossom and Rincon Rocks in the harbor of San Francisco, with the view to their removal.
2. Survey of the upper Columbia river, Oregon.
3. Survey of Crescent City harbor.

I. *Survey of Blossom and Rincon Rocks.*—A report upon the removal of Rincon Rock was included in the report from this office of January last. Experiments have been made upon Blossom Rock in order to estimate the cost of its removal. From the report of Lieutenant Heuer, corps of engineers, who had immediate charge of these experiments, the amount expended on them was $3,148 05, and the quantity of stone removed, 69 cubic yards. This expenditure would have been much greater but for the assistance of the United States Coast Survey in furnishing a vessel, officers and crew. Lieutenant Heuer estimates for the probable cost of removing Blossom Rock, and which should be appropriated for the next fiscal year, $60,000.

(See Appendix S.)

II. *Survey of the Upper Columbia.*—On the upper Columbia, no work has been done up to July 1, owing to the state of the river. A preliminary examination of the river has been made, as well as all preparations to prosecute the work with vigor after its commencement. A letter from the President of the Oregon Steam Navigation Company, giving much information upon the commerce and navigation of the upper Columbia, will be found in the Appendix.

(See Appendix S, S 1, and S 2.)

III. *Survey of Crescent City harbor.*—Colonel Williamson reports upon this work as follows: "No survey of Crescent City harbor was deemed necessary, as the chart of this locality by the United States Coast Survey is sufficiently in detail to determine the position and extent of the proposed breakwater." It should be 3,760 feet long, with a height varying between 28 and 32 feet, and a cross section as strong as that of the Delaware breakwater. This would afford a well protected harbor, ample in area and depth. The amount of stone required for such a work would be about 400,000 cubic yards, but the cost of putting this in place is so indefinite as to make it impossible to estimate the total cost, except very roughly. It may be set down at $2,000,000, but might exceed largely that amount. It is probable that constant dredging would be required to maintain a proper depth in the harbor.

The argument in favor of a work of this kind is, that Crescent City is the only position between San Francisco and Cape Flattery, where a harbor of refuge can be made. But it has only one or two hundred inhabitants, and the country in rear is sparsely settled or in dense forest. In view of these facts and the large expenditure for the construction of a breakwater, an appropriation for the commencement, at the present time, of such a work at Crescent City is not recommended by the engineer in charge.

(See Appendix S and S 3.)

Public buildings, grounds, and works in the District of Columbia.

Officer in charge, Major and Brevet Brigadier General N. Michler, corps of engineers.

Upon the transfer of public buildings, grounds and works to the direction of the Chief of Engineers, Major and Brevet Brigadier General N. Michler, corps of engineers, was assigned to their charge, including the Washington aqueduct. The report of that officer is appended hereto. Having been previously charged with surveys and plans for a national park, and the selection of a site for a presidential mansion, his report in relation to those subjects is likewise appended.

In the first named report the condition of the public works in the city of Washington and District of Columbia is stated in detail, and suggestions are offered as to such further improvements that are necessary for the convenience of the public service, the health of the inhabitants and the proper arrangement of the grounds and avenues.

The bridges across the Potomac and Eastern Branch have been placed in passable condition. Some of them require additional repairs.

The fence around the botanical garden and the culvert through it have been completed as far as the appropriations will admit.

General Michler recommends that Tiber creek be arched over as far as the northern limits of the city, and that certain improvements relating to the Washington canal be made.

With few exceptions the public squares have been placed in excellent condition. Authority is asked to enclose and improve several others, more especially the mall.

Suggestions are made in reference to the removal of the public market-houses and the erection of suitable buildings.

The avenues have been placed in as good repair as the means provided would admit, the greater amount of labor having been devoted to Pennsylvania and Virginia avenues; on others, nuisances growing out of insufficient drainage have been abated and improvements made. General Michler recommends that Pennsylvania avenue be repaved with some one of the more recent and improved pavements, either of stone or wood.

The estimated cost of carrying out these recommendations, which are approved, is $713,931 88.

(See Appendix T, T 1, and T 2.)

WASHINGTON AQUEDUCT.

A detailed report upon the different works completed along the line of the Washington aqueduct is submitted by General Michler, with suggestions and recommendations for the completion of the unfinished parts of the aqueduct, at an estimated cost of $712,838.

The recommendations are approved.

(See Appendix T and T 3.)

Survey of the North and Northwest lakes.

Officer in charge, Lieutenant Colonel and Brevet Brigadier General W. F. Raynolds, corps of engineers, assisted by Captain and Brevet Lieutenant Colonel F. U. Farquhar and Lieutenants M. R. Brown, J. F. Gregory, J. Mercur, and B. D. Greene, corps of engineers. One steamer and two shore parties were engaged during the summer of 1866 on Lake Michigan, carrying the surveys of both shores to the southward, and in executing the primary triangulation, off-shore sounding, &c.

The work was carried on the west side to a point near Two Rivers, Wisconsin, and on the east side of the lake to Little Point au Sable, giving a connected survey from these points to the foot of Lake Huron and head of Green bay.

Two steamers and two shore parties were engaged in Lake Superior in connecting previous surveys in Keweenaw bay and at Marquette, in making reconnoissance for primary triangulation over the entire lake, and in making a hydrographical survey from Keweenaw Point to Grand island.

Three astronomical parties were engaged during the first of the season in Lake Superior, and subsequently in Lake Michigan, in determining the latitudes of points by the aid of the differential zenith telescopes, and differences of longitude by means of instantaneous signals, and also in reading the angles of primary triangles at some of the points occupied. Seven (7) points in Lake Superior and eight (8) in Lake Michigan were occupied.

In the months of April and May, 1867, parties on board three steamers were engaged in the survey of the St. Clair river, and the survey was completed from Port Huron to include the greater portion of the delta.

The above work on Lakes Michigan and Superior was plotted during the past winter, and comprised twenty-six sheets of antiquarian paper, embracing 2,725½ square inches of topography and 2,290¾ square inches of hydrography. The St. Clair work has not yet been projected, the parties having gone into other fields immediately upon its completion.

Five thousand four hundred and sixty-four lake survey charts were distributed during the year, showing an increase of 1,829 over the distribution of the previous year. One detail chart of the south end of Green bay, on a scale of one-one hundred and twenty thousandth, ($\frac{1}{120000}$,) and one of the south end of Lake Michigan, including the Straits of Mackinac and Green bay, on a scale of one-four hundred thousandth, ($\frac{1}{400000}$,) have been completed for publication.

The amount required for the next fiscal year, including the amount withheld from the estimate of last year by the terms of the act of appropriation approved March 2, 1867, is $242,000.

(See Appendix U.)

Reconnoissances and explorations.

An officer of engineers has been on duty in each of the military divisions of the Missouri and the Pacific, and in each of the military departments of the Missouri, of the Platte, and of Dakota, on the staff or subject to the orders of the division or department commanders. The chief duties of these officers have been reconnoissances and surveys, and the preparation of sketches and maps, and their distribution within the commands to which they were attached. No special reports of operations have been received from these officers, with the exception of Major and Brevet Lieutenant Colonel R. S. Williamson, who reports, in relation to the surveys and maps in the division of the Pacific, that a military reconnoissance was made of the country lying between Fort Churchill, Nevada, and Ruby City, Idaho, with the view of furnishing a more direct wagon route connecting these points.

From the notes of this reconnoissance, and a similar one of the year previous, a map has been made of that comparatively unknown region. A reduced copy of this has been published in a cheap form, by authority of the major general commanding the division of the Pacific. A map of the whole of California, Nevada, Oregon, and a portion of Idaho, in one sheet, and also a map of Arizona, are in progress, and are nearly completed. These maps will represent all the known portions of these regions in much detail.

A topographical assistant has been sent by Colonel Williamson to Arizona, with instructions to accompany scouting parties and trains and gather such topographical information as can be obtained in that manner. Two other assistants have been sent with the party of the State geologist of California through the portion of the State of Nevada lying between the 37th and 38th parallels of latitude. From these very interesting results are expected, the country being nearly unknown.

Colonel Williamson has been instructed to report upon the subject of organizing an exploring party for the Colorado river, commencing at the point where the former exploration terminated. A report in relation to such an exploration was made to the Secretary of War in May last, a copy of which is hereto appended. (See Appendix V.)

In accordance with the third section of the act of Congress, approved March 2, 1867, authorizing the Secretary of War to direct a geological and topographical exploration to be made of the territory between the Rocky mountains and the Sierra Nevada mountains, including the route or routes of the Pacific railroad, instructions were prepared at these headquarters for the government of the geologist appointed to take charge of the explorations, (Mr. Clarence King,) which have in view the examination of the mountain ranges, rock formations, detrital plains, soils, saline and alkaline deposits, mines, coal deposits, minerals, ores, &c., and the collection of all data for detailed topographical maps, as well as maps of the mining districts, &c. The party was partly organized in New York, proceeded to California, where the outfit was completed, and then started for the field of operations in Nevada, where, at the date of the latest report, it was actively engaged in prosecuting its labors. The party will pass the winter in the field of exploration, and will resume its operations as early in the spring as the season will admit.

(See Appendix V 1.)

Much progress has been made in the recompilation of the map of the territory between the Mississippi river and the Pacific ocean. Valuable results of the labors of the northwest boundary commission were kindly furnished by the commissioner, Mr. Archibald Campbell, which have been used in the compilation; also, the surveys at the head-waters of the Yellowstone and Missouri rivers by Brevet Brigadier General W. F. Raynolds, corps of engineers, and additional information furnished by Brevet Major General G. K. Warren, corps of engineers, and astronomical positions by Brevet Brigadier General Comstock, corps of engineers.

The engraving of the map has progressed with the compilation, and from time to time editions have been issued for the use of the troops occupying the country. A map of Kansas, Texas, and the Indian territory has within the last year been compiled and engraved, for the use of troops operating therein. The general map of the country west of the Mississippi river, exhibiting the military departments and posts, has been extensively distributed in answer to the demand for it. This map is based upon the map first referred to above. The positions occupied by troops and those abandoned have been verified in a great measure by Brevet Brigadier General Comstock and Brevet Colonel Merrill, corps of engineers.

The demand for maps has required the constant application of the employés of the office in their preparation, which have been multiplied either by photography or by engraving; of the former there have been printed 1,335 sheets, and of the latter 8,708 sheets.

Maps of campaigns and battle-fields.

Two general maps—one illustrating the campaigns of Lieutenant General Sherman, the other the campaigns of Major General Thomas—are in the hands of the engravers, and are nearly finished. Much progress has been made in the preparation of the detailed maps intended to illustrate the principal campaigns of the latter part of the war. They should be published, not only for the explanation of the official reports upon the great operations of the war, but for the valuable information they afford for military and civil uses.

Major and Brevet Brigadier General N. Michler has charge of the preparation of these, fifty in number, connected with the operations in Virginia. These maps are substantially finished. Colonel Edward Ruger, late of the volunteers, has charge of the preparation of the maps exhibiting the operations of the western armies.

An appropriation of fifty thousand dollars for engraving and printing the most important of these maps is recommended to be made. The amount on hand of the appropriation for surveys for military defences, &c., is sufficient for the present and next fiscal year, a considerable balance having been left on hand at the close of the war.

In the labors of this office during the fiscal year I have been assisted by the following officers, charged with the direction of the four divisions among which its duties are distributed:

Fortifications—Brevet Major General Q. A. Gillmore, Brevet Major General H. G. Wright, Brevet Colonel J. D. Kurtz.

Armament, personnel, orders, &c.—Brevet Colonel J. D. Kurtz.

River and harbor improvements and surveys, survey of the lakes, military and geographical surveys and explorations—Brevet Brigadier General I. C. Woodruff.

Finances, accounts, estimates, lands—Brevet Lieutenant Colonel W. P. Craighill.

On special duty—Brevet Major W. R. King.

Very respectfully, your obedient servant,

A. A. HUMPHREYS,
Brigadier General of Engineers, Commanding.

General U. S. GRANT,
Commanding Armies of the United States,
Secretary of War ad interim.

APPENDIX A.

Extracts from the annual report of Brevet Colonel J. B. Wheeler, major of engineers, upon the lake harbor improvements under his direction.

* * * * * * * * *

The assistants in charge of the harbors are required to visit those under their charge at least once during each month, and oftener if necessary. They are required to make inspection of work and materials offered by contractors, and see that the plan proposed for the improvement of the harbor is strictly complied with. To assist them in these duties a foreman is employed at each harbor, who keeps a daily record and reports weekly to each inspector the quantity of materials received, accepted, rejected, and the amount of labor performed. These reports are duly entered upon books of record, and kept on file in this office.

Payments are made from time to time, generally once a month, to contractors for the materials furnished or work done, provided satisfactory progress is shown. Each voucher before payment passes through the hands of the assistant, who makes a critical examination as to the quantities, and compares them with his record book. All vouchers are paid by myself, as the regulations require the senior engineer officer to be the disbursing officer.

* * * * * * * * *

In concluding this my annual report for 1867, I would say a few words concerning the general plan of improvement adopted and the character of the estimates made. The plan of improvement consists in a system of jettees or piers, extending into deep water, confining the volume of river water emptying into the lake. This plan meets with the approbation of all persons. Various opinions, however, are expressed as to the composition, construction, and direction of the piers. Again, discussions arise as to the length of the piers—which should be longer of the two, or whether they both be made of equal length.

My opinions are decided on these points, as far as the general class of improvements are concerned. The plan of piers composed of cribs with grillage bottoms, conforming to the general principles laid down by the board of engineers, is the one adopted by me as fulfilling all the purposes required, and possessing superior excellence over the other plans proposed. The direction of the piers and their respective lengths admit of discussion. I am in favor of the piers being parallel and equal in length. Their direction should be a prolongation of the last course of the river before meeting the obstacles thrown up by the lake, avoiding particularly all angles or deflections of the course as the stream enters the lake. The general use of steam power renders this more practicable than in former days, when sailing vessels only were used, and great stress was laid upon wide entrances and weather piers.

The estimates offered are generally based upon the prices paid for materials and labor at the nearest harbor where improvements are made, and are as close as could be made. Probably materials could be furnished more cheaply and labor would cost less at some of the points named. I have thought it best to be safe in the estimates, by comparing the cost at other harbors where the actual experiment had been made of letting the work by contract, and basing the estimates on these prices.

Accompanying this report are the following maps and tracings, made up in a separate package, viz:

1. Map of Racine reef, on scale of $\frac{1}{9600}$.
2. Tracing of Racine reef, on scale of $\frac{1}{5000}$.
3 Tracing of Racine reef, on scale of $\frac{1}{3600}$.
4. Tracing of entrance to harbor of Racine on scale of $\frac{1}{3600}$.
5. Tracing of harbor of Saugatuck, Kalamazoo river, on scale of $\frac{1}{4800}$.
6. Tracing of mouth of Menomenee river, Green bay, on scale of $\frac{1}{4800}$.
7. Tracing of entrance to harbor of Milwaukee, Wisconsin, on scale of $\frac{1}{3600}$.
8. Plan of crib 32′ × 20′ × 17′.

The army regulations require that "an engineer superintending a work or operation shall disburse the money for the same," &c. This regulation compels me to disburse money from twenty-four (24) different appropriations, and to render monthly twenty-four (24) sets of accounts. Under the present law and regulations the number of papers required are many, and the greater part of my time is occupied in seeing these papers properly prepared and signing them. Can there be no amelioration made in the law or regulations that would reduce this labor? A return to the quarterly system of rendering accounts, as practiced before 1861, would reduce the labor and the expense very materially. If this be not practicable, a division of the labor among the assistants would lighten the weight of the onerous burden now resting upon me.

Attached, marked A, is an abstract of all contracts for the harbors under my charge, with names of contractors and prices paid.

Also, marked B, is an abstract of the harbors, giving their locality, amounts required for completion, amounts for next fiscal year, &c.

It is well to state that the word "completion" is relative, meaning, in this case, the completion of the present plan. From the very nature of things, and this kind of work, a permanent completion cannot be expected.

I wish to return thanks to the headquarters corps of engineers for the promptness that has ever been shown in replying to all my requisitions and requests. I wish to acknowledge the kindness that Brevet Brigadier General W. F. Raynolds, corps of engineers, superintendent of lake survey, has shown me in furnishing maps, tracings, and information upon my application. My assistants, as named on page three of this report, have been prompt, active, and efficient, and I am much indebted to them for their services.

APPENDIX A.

Abstract of contracts entered into by Major and Brevet Colonel J. B. Wheeler, corps of engineers, for the several works of harbor improvement in his charge.

Harbor.	Name of contractor.	Material or labor contracted for.	Price.
Superior City, Wis..	Peter White	Iron bolts....per lb..	$0 05
Do	......do	Spike....per lb..	05
Do	Coburn & Ray	Framing....per lin. ft..	20
Do	David Smoke	Twelve-inch pine timber....per lin. ft..	20
Do	......do	Piles....per lin. ft..	15
Do	......do	Stone....per cord..	11 00
Do	......do	Brush....per cord..	3 00
Ontonagon, Mich	S. S. Vaughn	Stone....per cub. yd..	3 75
Do	......do	Brush....per cord..	6 00
Do	Peter White	Iron bolts....per lb..	05
Do	......do	Spikes....per lb..	05
Do	Gelley & Weston	Twelve-inch pine timber....per lin. ft..	15 7-10
Do	......do	Plank....per M, (b. m.)..	18 00
Do	......do	Piles....per lin. ft..	08
Do	......do	Framing....per lin. ft..	16 7-10
Eagle Harbor, Mich.	David Quinn	Removal of rock....per cub. yd..	58 00
Marquette, Mich	William Ferguson	Twelve-inch pine timber....per lin. ft..	14½
Do	......do	Stone....per cub. yd..	1 25
Do	......do	Brush....per cub. yd..	1 25
Do	......do	Plank....per M, (b. m.)..	16 00
Do	Peter White	Iron bolts....per lb..	04½
Do	......do	Spikes....per lb..	04½
Do	Gelley & Weston	Framing....per lin. ft..	10 7-10
Green Bay, Wis	William S. Smith	Dredging....per cub. yd..	50
Manitowoc, Wis	David Smoke	Twelve-inch pine timber....per lin. ft..	15
Do	......do	Twelve-inch hemlock timber....per lin. ft..	14
Do	......do	Stone....per cord..	9 50
Do	......do	Brush....per cord..	2 00
Do	......do	Framing....per lin. ft..	15
Do	......do	Driving piles....each..	3 00
Do	......do	Placing and sinking cribs....	90 00
Do	Hoes & Packard	Oak plank....per M, (b. m.)..	25 00
Do	......do	Pine plank....per M, (b. m.)..	18 00
Do	......do	Scantling....per M, (b. m.)..	18 00
Do	John Schutte	Dredging....per cub. yd..	20
Do	John Vilas	Iron bolts....per lb..	07½
Do	......do	Spikes....per lb..	12
Sheboygan, Wis	Dillingham & Co	Twelve-inch oak timber....per lin. ft..	27
Do	......do	Twelve-inch pine timber....per lin. ft..	24
Do	......do	Plank and scantling....per M, (b. m.)..	25 00
Do	......do	Piles, white oak....per lin. ft..	16
Do	Locklie & Jenkins	Stone....per cord..	10 00
Do	Sanger, Ledlie & Corse.	Brush....per cord..	6 00
Do	......do	Iron bolts....per lb..	10
Do	......do	Spikes....per lb..	10
Do	......do	Framing....per lin. ft..	19
Do	......do	Placing cribs....each..	49 00
Do	......do	Dredging....per cub. yd..	49
Do	......do	Driving piles....per lin. ft..	19
Milwaukee, Wis	J. Kuhlman	Stone in cribs....per cub. yd..	2 70
	1866.		
Racine, Wis	Sanger, Ledlie & Corse.	Piles, white oak....per lin. ft..	19
Do	......do	Plank, three-inch....per M, (b. m.)..	30 00
Do	......do	Scantling, three-inch....per M, (b. m.)..	30 00
Do	......do	Twelve-inch timber....per lin. ft..	24
Do	......do	Iron bolts and spikes....per lb..	10
Do	......do	Brush....per cord..	6 00
Do	......do	Stone....per cord..	13 89
Do	......do	Placing cribs....each..	39 00
Do	......do	Driving piles....per lin. ft..	19
Do	......do	Framing....per lin. ft..	16
Do	......do	Dredging....per cub. yd..	49

CONTRACT OF 1867.—REPAIRS TO BE PAID FOR AT RATES FIXED BY ENGINEER OFFICER IN CHARGE.

Racine, Wis	P. M Danaher	Twelve-inch timber....per M, (b. m.)..	$14 97
Do.	......do	Three-inch plank....per M, (b. m.)..	14 97
Do.	......do	Framing....per lin ft..	13½
Do.	Ledlie & Corse	Stone....per cub. yd..	2 69
Do.	......do	Brush....per cord..	5 40
Do.	R. Nelson Gere	Iron bolts....per lb..	05
Do.	......do	Spikes....per lb..	07

Abstract of contracts—Continued.

CONTRACT OF 1867, ETC.—Continued.

Harbor.	Name of contractor.	Material or labor contracted for.	Price.
Kenosha, Wis	Sanger, Ledlie & Corse	Piles per lin. ft	$0 19
Do	do	Three-inch plank, oak per M, (b. m.)	35 00
Do	do	Three-inch plank, pine per M, (b. m.)	30 00
Do	do	Three-inch scantling per M, (b. m.)	30 00
Do	do	Twelve-inch timber, pine per lin. ft	29
Do	do	Twelve-inch timber, oak per lin. ft	39
Do	do	Iron bolts and spikes per lb	10
Do	do	Brush in cribs per cord	5 00
Do	do	Stone per cord	13 87
Do	do	Driving piles per lin. ft	13
Do	do	Framing per lin. ft	16
Do	do	Placing cribs each	39 00
Do	Caleb H. Parker	For dredging between the piers and for foundations for cribs per cub. yd	37
Do	do	Dredging on bars or points outside of proposed extension per cub. yd	74
Chicago, Ill	John M. Corse	Twelve-inch timber per lin. ft	28
Do	do	Three-inch plank per M, (b. m.)	31 75
Do	do	Brush per cord	5 74
Do	do	Stone per cord	8 74
Do	do	Delivering and driving white oak piles each	11 98
Do	do	Framing and sinking cribs per lin. ft	11½
Do	do	Iron bolts per lb	09½
Do	do	Spikes per lb	14½
Do	do	Dredging inside of pier per cub. yd	44
Do	do	Dredging outside of pier per cub. yd	74
Michigan City	F. A. Slater	Twelve-inch timber per lin. ft	14
Do	do	Three-inch plank per lin. ft	......
Do	do	Framing per lin. ft	13
Do	Chapin & Wells	Iron bolts per lb	04½
Do	do	Spikes per lb	06½
Do	J. D. Dolan	Stone per cub. yd	2 62½
Do	do	Brush per cub. yd	75
New Buffalo	Carkin & Kimball	Twelve-inch timber per M, (b. m.)	15 00
Do	do	Three-inch plank per M, (b. m.)	16 00
Do	do	Piles per lin. ft	08
Do	do	Stone per cord	15 75
Do	do	Brush per cord	2 90
Do	do	Framing per lin. ft	08½
Do	do	Driving piles per lin. ft	06½
Do	do	Dredg'g and excav'g in ord'ry mat'al. per cub. yd	34
Do	do	Dredg'g and excav'g in hard mat'al. per cub. yd	70
Do	R. Nelson Gere	Iron bolts per lb	04 9-10
Do	do	Iron spikes per lb	04 9-10
St. Joseph	Hasbrouck & Conro	Oak piles each	16 00
Do	do	Twelve-inch timber per lin. ft	35
Do	do	Brush per cord	3 00
Do	do	Stone per cord	15 00
Do	do	Iron bolts per lb	10
Do	do	Iron bolts with screw and nut per lb	18
South Haven	Galen Eastman	Twelve-inch timber per M, (b. m.)	13 25
Do	do	Three-inch plank per M, (b. m.)	15 00
Do	do	Piles per lin. ft	08
Do	do	Stone per cord	14 37½
Do	do	Brush per cord	2 00
Do	R. Nelson Gere	Iron bolts per lb	04 9-10
Do	do	Spikes per lb	04 9-10
Do	George Hannahs	Framing per lin. ft	14½
Black Lake	John Roost	Twelve-inch timber per lin. ft	20
Do	do	Three-inch plank per M, (b. m.)	25 00
Do	do	Sink pieces, placed per sq. yd	3 70
Do	S. N. Kimball	Stone per cord	13 40
Do	do	Brush per cord	3 00
Do	James H. Ledlie	Iron bolts 1½-inch square per lb	06 9-10
Do	do	Iron spikes, 6-inch per lb	15
Do	James E. Miller	Framing per lin. ft. of timber	09
Do	do	Filling cribs with stone per cord	80
Do	do	Dredging in ordinary material per cub. yd	34½
Do	do	Dredging in hard pan or slip clay per cub. yd	69
Grand Haven	James H. Ledlie	Twelve-inch timber per lin. ft	22
Do	do	Three-inch plank per M, (b. m.)	25 00
Do	do	Pine piles per lin. ft	08
Do	do	Oak piles per lin. ft	17
Do	do	Stone per cord	16 94
Do	do	Brush per cord	2 20
Do	do	Iron bolts per pound	09
Do	do	Iron spikes per pound	14
Do	do	Framing per lin. ft. of timber	11

Abstract of contracts—Continued.

CONTRACT OF 1867, ETC.—Continued.

Harbor.	Name of contractor.	Material or labor contracted for.	Price.
Grand Haven	James H. Ledlie	Driving piles per lin. ft.	$0 07½
Do	R. A. Conolly	Twelve-inch timber per lin. ft. of timber	24 00
Do	do	Pine piles per lin. ft.	10
Do	do	Stone per cord	18 75
Do	do	Brush per cord	1 75
Do	do	Iron bolts and spikes per lb	09
Do	do	Driving piles each	1 75
Do	do	Framing per lin. ft. of timber	09
Muskegon	Galen Eastman	Twelve-inch timber per M, (b. m.)	12 83
Do	do	Three-inch plank per M, (b. m.)	14 00
Do	do	Piles per ft.	08
Do	Ledlie & Corse	Stone per cord	13 88
Do	do	Brush per cord	2 00
Do	R. Nelson Gere	Iron bolts and spikes per lb	04 9-10
Do	Heber Squier	Framing per lin. ft. of timber	12
White River	Thomas L. White	Twelve-inch timber per lin. ft. of timber	14 1-10
Do	do	Three-inch plank per M, (b. m.)	14 50
Do	do	Piles per lin. ft.	07
Do	Carkin & Kimball	Framing per lin. ft.	07
Do	do	Driving piles per lin. ft.	05½
Do	do	Stone per cord	14 90
Do	do	Brush per cord	1 42
Do	R. Nelson Gere	Iron bolts and spikes per lb	04 9-10
Do	Fox & Howard	Dredging per cub. yd	28
Pentwater	P. M. Danaher	Twelve-inch timber per lin. ft.	12
Do	do	Three-inch plank per M, (b. m.)	12 00
Do	do	Piles per lin. ft.	08
Do	F. D. Van Wagener	Stone per cord	16 00
Do	do	Brush per cord	6 00
Do	R. Nelson Gere	Iron bolts and spikes per lb	04 9-10
Do	Hasbrouck & Conro	Framing per lin. ft.	14
Do	do	Dredging per cub. yd	36
Pere Marquette	P. M. Danaher	Twelve-inch timber per lin. ft.	12½
Do	do	Three-inch plank per M, (b. m.)	18 00
Do	do	Piles per lin. ft.	08
Do	Ledlie & Corse	Stone per cord	13 98
Do	do	Brush per cord	1 49
Do	R. Nelson Gere	Iron bolts and spikes per lb	04 9-10
Do	Hasbrouck & Conro	Framing per lin. ft.	14
Do	do	Dredging per cub. yd	36
Manistee	Gelley & Weston	Twelve-inch timber per M	12 90
Do	do	Three-inch plank per M	14 00
Do	do	Piles per lin. ft.	08
Do	Galen Eastman	Stone per cord	14 88
Do	do	Brush per cord	2 00
Do	R. Nelson Gere	Iron bolts and spikes per lb	04 9-10
Do	H. Starke	Framing per lin. ft. of timber	15
Aux Bec Scies	Whitwood & Hubbell	Twelve-inch timber per lin. ft.	18
Do	do	Three-inch plank, pine per M, (b. m.)	20 00
Do	do	Piles, (30 feet long,) oak each	5 75
Do	do	Piles, (30 feet long,) elm each	2 75
Do	do	Stone per cord	17 00
Do	do	Brush per cord	4 50
Do	do	Slabs per cord	2 50
Do	do	Iron bolts, 1½-inch per lb	06
Do	do	Iron spikes, 6-inch per lb	07½
Do	do	Driving piles each	6 00
Do	do	Framing and building cribs each	168 00
Do	do	Placing, sinking, and filling each	30 00
Do	do	Dredging in common earth, sand, or soft clay per cub. yd	35
Do	do	Dredging in hard clay and hard pan per cub. yd	70

A 1.

ONTONAGON, MICHIGAN,
August 31, 1867.

SIR: In obedience to your instructions, embraced in the circular of July 20, 1867, I present a general report of the harbor improvements under my charge, which include Superior City, Ontonagon, and Eagle harbor.

I am not prepared to report on Eagle harbor. The first notice of its assignment to my care was received at Milwaukee July 31, and my time has been fully occupied at the other points since my arrival on Lake Superior. I will at an early day examine that harbor, and present a separate report.

We will first refer to the harbor of Superior City. This will be to some extent a repetition of my communication or report of July 26, 1867, on the harbor of Superior City. This harbor is at the western extremity of Lake Superior, and, in natural advantages of location, it is to Lake Superior and the country south and west and northwest what the harbor of Chicago is to Lake Michigan and the regions in the same directions. As a depot for the reception and forwarding of wheat from places of production, the bay of Superior may eventually become the greatest in the world. The distance from Superior City by lake and canal navigation to tide water is about the same as from Chicago. The commerce of Superior City is very small at present, as its communications have never been opened with the country from the south to the west and northwest, which will become tributary.

Five different railways, all having valuable land grants, are expected to terminate at Superior City or on the bay of Superior, viz: The Northern Pacific, the Mississippi and Lake Superior, (from St. Paul's,) the Lake Superior branch of the St. Paul's and Pacific, the St. Croix and Lake Superior, and the Portage and Superior. Hence the harbor of Superior seems by far to be the most important on the lake, and one of the most important in all the great chain of lakes.

The improvement should be begun and carried forward in the most substantial manner. The bay of Superior is the second widening of the St. Louis river, the first being the St. Louis bay above. Both of these bays seem to have been, at periods not very remote, the proper termini of the lake, the points of land which separate the two bays having first been formed by the united action of the lake and St. Louis river, and afterwards the Minnesota Point was formed by the same agencies, beginning at the Minnesota bluffs and extending gradually to its present length, which has been increased within the last six years. A similar process has been going forward in the formation of Wisconsin Point and bay of Allowes, in the connection with the Nemadjii river and other streams emptying into the bay of Allowes, all concentrated and flowing through a circuitous channel from the bay of Superior into Lake Superior, between Minnesota and Wisconsin Points. The St. Louis river probably discharges at least five times the quantity of water as the Nemadjii, but as it spreads over the large bay of St. Louis and Superior, the proportionate amount of sediment carried into the lake by the Nemadjii is very greatly increased, especially in times of freshets such as came under my observation from the 18th to 24th of July, 1867. The plan which has been proposed for improving the harbor is to extend a pier of cribs from Wisconsin Point straight into the lake, in a nearly northeast direction, skirting the easterly side of the channel for some distance, then across the bar to sixteen feet depth of water in the lake, a distance of about two thousand feet. On the other side of the channel it is proposed to place loose rock along the inside of the Minnesota Point, (or rather the extension of the same, which is rapidly forming,) for a distance of about one thousand feet, and then begin the crib-work and gradually contract the channel to three hundred feet in width. This plan will require about seven hundred cords of loose rock or filling, and about forty-three hundred feet length of cribs, and about forty-two thousand yards dredging. The estimates of this work are annexed.

The plan which I have recommended in a former communication is to restore a former channel of the St. Louis river by cutting across Minnesota Point about one and one-fourth mile northwest of the light-house, thus avoiding the circuitous channel of the present natural entrance and the sediments of the Nemadjii river and a portion of the St. Louis, and the accumulations of sediment which extend nearly half a mile into the lake.

At the proposed point the land is narrow and low, being about two hundred feet from the lake to the bay shore, and eighteen feet of water within six hundred feet of lake shore, and eleven feet within the same distance from the shore of the bay. I would recommend an artificial channel not exceeding two hundred feet in width, which should not be opened for the passage of water till the crib-work is as nearly as possible completed. The sides of the artificial channel should be cribbed to a depth of at least twelve feet below the surface of the water; and when finished a part of the ordinary current of the St. Louis river would pass through it, on the principle that water will seek its level on the shortest distance, and thus keep the channel clear till the further extension of the cribs into the lake should be required. The effect of this might be to diminish the depth of water in the present channel, as it would divide the current with it, but it would not close up, as it would still remain the most natural outlet of the Nemadjii, and the proposed cut would be insufficient for the St. Louis in time of freshets. The amount of work required for the full improvement of the harbor would be less on the artificial channel, and the facility of doing it would be much greater than at the present entrance. There would be no current to contend with, and more than half the work could be done in the protection of the bay. For these reasons the same amount of work at the cut can be done at much less actual cost. The effect of projecting piers into the lake at either place may be to cause an abrasion on the lake shore northwest of the pier, which may in such case be remedied by small jettees into the lake at those points. The difference of level of the water of the bay and lake at the light-house on the 22d of July last, two days after the freshet began to subside, was seventy-six one-hundredths of a foot. This caused a rapid current through the channel.

By reference to the chart the advantages of the artificial channel are so obvious that the subject needs no further comment. A good harbor can be made by improving the present entrance; but a better one can be secured by the cut, at a less original cost and less for future maintenance; but it is possible that private interest might be so effected or invaded as to make it most expedient to maintain the natural channel. I do not fully understand the law and equity of this subject. It has been intimated that the owners of property on the bay near the Nemadjii river claim to foresee damage to their property by changing the natural outlet of the St. Louis river; but if the public advantages are very great and obvious, it seems as though such private claims could hardly be maintained either in law or equity. The work already done in the improvement of the harbor and materials delivered are as follows:

374½ cords of stone deposited along the inside the Minnesota Point, at $11 per cord	$4,119 50
20,200 lbs. iron bolts and spikes delivered, at 5 cents	1,010 00
Total	5,129 50

It is expected that the full amount of the present appropriation can be profitably expended during the present fiscal year. During the next fiscal year one hundred and twenty thousand dollars ($120,000) can be profitably expended.

The following are the estimates of the cost of improving the harbor on each of the different plans, and annexed thereto are the abstracts of contracts and tables of commerce, &c. Superior City is in the collection district of Michilimackinac. The nearest port of entry is Bayfield; the nearest light-house is at Raspberry island, which is a flash light. There were no import duties collected at Bayfield during the last year. There were thirty-four arrivals and thirty-three departures of vessels to and from Superior City during the year ending June 30, 1867.

Abstract of contracts for improvement of the harbor of Superior City.

Names of contractors.	1st class, timber.			2d class, iron.		3d class, filling.		4th class.	5th class.
	Pine per lineal foot.	Plank per M., b. m.	Piles per lineal foot.	Bolts per lb.	Spikes per lb.	Stone per cord.	Brush p'r cord.	Framing per lineal foot.	Dredging per cubic yard.
	Cents.		*Cents.*	*Cents.*	*Cents.*			*Cents.*	*Cents.*
R. G. Coburn	24	$16	13					20	48
Peter White				5	5				
David Smoke						$11	$3		

Estimate of cost of improving the harbor of Superior City at the present entrance.

Cost of one crib 32′×20′×17′:

2, 368 feet, (lineal,) 12×12 timber in the work, at 44 cents	$1, 041 92
288 feet b. m. plank in the work, at $25	7 20
56 cords stone filling, at $11	616 00
7 cords brush filling, at $3	21 00
3 piles driven in work, say	23 88
3, 560 pounds iron bolts and spikes, at 5 cents	178 00
Total	1, 888 00

Cost per lineal foot, $59.

4, 300 lineal feet of crib piers, at $59, averaging 17 feet in depth and 20 feet wide	$253, 700 00
42, 000 cubic yards dredging, at 48 cents	20, 160 00
700 cubic yards loose rock, at $11	7, 700 00
Add ten per cent. for superintendent contingencies	28, 156 00
Total	309, 716 00

Estimate of cost of improving the harbor of Superior City, at the proposed cut, exclusive of land damages.

3, 000 lineal feet of crib piers, averaging 17 feet in depth and 20 feet wide, at $59 per foot	$177, 000 00
110, 000 cubic yards dredging and excavating, at 48 cents	52, 800 00
Add ten per cent. for superintendent contingencies	22, 980 00
Total	252, 780 00

There were no foreign exports or imports at Superior during the year ending June 30, 1867.

DOMESTIC EXPORTS.		DOMESTIC IMPORTS.	
Lumber, feet, b. m.	1,879,273	Flour, barrels	1,236
Shingles, feet	255,000	Pork, barrels	194
Laths	500,000	Corn meal, barrels	273
Fish, half barrels	1,478	Salt, barrels	352
Cattle	170	Corn, bushels	2,762
Furs, bales	13	Oats, bushels	5,352
Merchandise, tons	28	Merchandise, tons	419

Respectfully submitted:

HENRY BACON, *Assistant.*

Colonel J. B. WHEELER,
Major of Engineers, U. S. Army.

A 2.

The harbor of Ontonagon is situated at about an equal distance between the natural harbors of the Apostle islands and Copper Harbor, it being about one hundred and sixty miles from Bayfield to Copper Harbor, with no other intermediate harbor excepting Eagle Harbor, fourteen miles from Copper Harbor, which, till improved, is very difficult of access. There are no other intermediate places where artificial harbors can be made to advantage. If there were no trade or commerce, present or prospective, at Ontonagon, it would be very necessary to improve the harbor as a harbor of refuge.

Lake Superior, like the other great lakes, is subject, at certain seasons, to sudden and violent storms and gales of wind, which make harbors of refuge not only desirable but essential to the safety of navigation.

It is very apparent that one is a necessity between Copper Harbor and the Apostle islands. The Ontonagon river, from its mouth about one mile, has a minimum depth of ten (10) feet, and eleven (11) feet to the dock. It has a minimum depth of six (6) feet for about six miles further up.

Ontonagon is the commercial centre of the best agricultural region of Lake Superior, though undeveloped, and also of one of the best mining regions, which, also, is partially developed.

The modern deposits of the Ontonagon river have extended about half a mile into the lake. Through this bar there is, at present, a channel somewhat circuitous, having about eleven feet minimum depth of water. This channel is variable, and has been, for several years before 1866, closed, so that vessels drawing more than seven feet of water could not enter during the years 1863, 1864, and 1865

The plan for improvement adopted is to extend two parallel piers of cribs in a direction nearly northwest, two hundred and fifty feet apart, and each about two thousand five hundred (2,500) feet into the lake.

The east pier will cross the present channel and cut across the bar for a distance of about one thousand feet, to eighteen feet of water into the lake. The east pier should be extended to the channel in the first place, and then the work should begin at the west pier; and it may be a question whether it will be best to extend the west pier to its full length, and then extend the east pier, leaving open a space for the channel to be closed last, after a channel is dredged through the bar between the cribs, leaving the spring and summer freshets to finish the channel. This position of piers involves more expense than a more northerly direction, as it requires more length and more dredging; but it is undoubtedly a more proper direction for permanence, as it carries the works beyond the extreme point of the bar formed by the river deposits, and is the best protection against the most prevailing winds, which are from the northeast.

The Ontonagon river, for several miles from its mouth, is a sluggish stream; but it is subject to heavy freshets in spring and summer, which bring down large amounts of drift-wood and deposits of sediment, both of which have helped to obstruct the entrance; and the same causes may, after a few years, make it necessary to extend the piers still further into the lake. If the work is completed according to the plan, in a proper manner, it will make Ontonagon a safe and acceptable harbor at all times during the navigable seasons.

A small amount of dredging needs to be done inside of the shore line to the docks, which properly belongs to private or local enterprise. There is no work done, in place, on the improvement of the harbor.

The materials delivered are as follows:

20,200 lbs. of iron bolts, at 5 cents	$1,010 00
1,500 cubic yards of stone for filling, at $3 75	5,625 00
1,200 lineal feet of timber, at $15\frac{7}{10}$ cents	188 40
Total	6,823 40

It is expected that work to the amount of the present appropriation can be done during the present fiscal year.

During the next fiscal year, one hundred and twenty-five thousand dollars ($125,000) can be profitably expended.

Ontonagon is in the collection district of Michilimackinac. The nearest port of entry is Eagle Harbor. The nearest light-house is at Eagle river, with a ——— light.

The revenue collected at the port of Ontonagon during the last fiscal year was $232 68; of which only $5 50 was from duties. The number of arrivals of vessels at the port was 224; departures, 225.

With these remarks I submit the following estimates, with abstracts of the contracts and tables of domestic exports and imports.

The estimates for Ontonagon and Superior are based upon the prices of the present contracts, and are for a thorough execution of the plans, which will make our work secure and permanent; requiring few repairs excepting the natural decay of the timber above the surface of the water.

Very respectfully, your obedient servant,

HENRY BACON, *Assistant.*

Abstract of contracts for the improvement of the harbor of Ontonagon.

Names of contract's.	1st class—Timber.				2d class—Iron.		3d class—Filling.		4th class—Fram'g. Per lineal foot.	5th class—Dredg'g. Per cubic yard.
	Pine, per lineal foot.	Oak, per M. (b. m.)	Plank, per M. (b. m.)	Piles, per lineal foot.	Bolts, per pound.	Spikes, per pound.	Stone, per cubic yard.	Brush, per cord.		
	Cents.			*Cents.*	*Cents.*	*Cents.*			*Cents.*	*Cents.*
Gelly & Weston	15 7-10	....	$18 00	08	....	....	....	....	16 7-10	....
S. S. Vaughn	....	....	....	....	....	....	$3 75	$6 00	....	40
Peter White	....	....	....	....	05	05	....	....	....	....

ESTIMATE OF THE COST OF IMPROVING THE HARBOR OF ONTONAGON.

Cost of one crib, 32′ × 20′ × 17′:

2,368 lineal feet of timber frames done in work, at 32$\frac{4}{10}$	$767 23
288 feet b. m. plank, at $25	7 20
265½ yards filling stone, at $3 75	995 62
7 cords filling brush, at $6	42 00
3 piles and driving	24 00
3,560 pounds iron and spikes, at 5 cents	178 00
Total	2,014 05

Or $62 94 per lineal foot.

ESTIMATE OF TOTAL COST.

5,000 lineal feet of crib piers, at $62 94	$314,700 00
40,000 cubic yards of dredging, at 40 cents	16,000 00
Add 10 per cent. for superintendence and contingencies	33,070 00
Total	363,770 00

DOMESTIC EXPORTS.

From the port of Ontonagon during the year ending June 30, 1867:

	Tons.
Copper, 1,500 tons	1,500
Hay, 100 tons	100
Fish, 1,000 half barrels	75
Leather, 50 tons	50
Potatoes, 2,000 bushels	60
Lumber, 125 M feet	.....
Sundries, 75 tons	75
Potash, 20 tons	20
Total tons	1,880

DOMESTIC IMPORTS.

To the port of Ontonagon during the year ending June 30, 1867:

	Tons.
Flour, 4,790 barrels	526
Lime, 420 barrels	53
Lard, 190 barrels	30
Molasses, 44 barrels	11
Oil, 123 barrels	19
Pork, 278 barrels	42
Sugar, 600 barrels	84
Salt, 600 barrels	90
Vinegar, 100 barrels	17
Fuze, 60 barrels	8
Hams, 384 casks	53
Nails, 160 kegs	8
Powder, 8,200 kegs	123

	Tons.
Candles, 2,000 boxes	70
Corn, 2,500 bushels	70
Oats, 17,000 bushels	272
Corn-meal	250
Sundries	1,375
Total	3,051

A 3.

MILWAUKEE, WISCONSIN, *August* 31, 1867.

COLONEL: I have the honor to submit the subjoined report of Marquette harbor, Michigan.

This harbor is situated about 170 miles from the south, at that point where the line of the south shore of Lake Superior changes its general direction from northwest and southeast to east by north and west by south. The harbor is formed by an indentation in the shore-line of about a mile to the westward, making a natural harbor secure from all winds except those from the east around to the northeast, and vessels at anchor in it are, in consequence, obliged to sail upon the slightest indication of a storm from these unsheltered directions. This harbor, therefore, needs the agency of art to render it perfectly secure.

The almost fabulous mineral richness of peninsular Michigan early attracted the attention of capitalists, who, in opening the mines, unearthed the talisman that dotted the shores with cities, filled the valleys with the busy hum of life, whitened the lake with the sail of vessels bearing to a market the products of the mines, caused prosperity to smile from the sterile rock, and spread the mantle of enterprise over a country wild and uninviting.

Marquette is a production of this genius of progress. In sailing up Lake Superior, upon emerging from the wild loneliness of the region below, one is filled with surprise and wonder at the first sight of so fine a town. The town is beautifully situated on a fine elevation that descends by gentle slopes to the shores of the bay. It has a population of about three thousand, which is rapidly increasing, and appearances indicate that about half of the buildings have been erected within two years, while still others are in process of construction.

The streets throughout the entire day resound with the hum of business, and in the evening, when the iron furnaces pour out their industrious swarm, they have a most lively appearance.

Through this port pass the productions of the iron furnaces, mines, and exchange commodities, and, therefore, anything that may be done at this place for the protection of shipping, during the tempestuous weather, will exert a most beneficial influence upon not only the tributary country and attendant commerce alone, but upon every vessel that encounters the fierce storms upon Lake Superior, the largest of the American lakes.

Marquette is in railroad communication with Escanaba, and another road is in course of construction between Marquette and Ontonagon, being completed as far as Lake Michigan. The several mines upon the lines of these roads transport most of their products by them to Marquette, where they are transferred to vessels and shipped for reduction and manufacture to points east.

In consideration of their vast extent, the iron mines of this country comprise, no doubt, the most wonderful mineral deposit in the world. Within the last fifteen years, millions of tons of ore have been excavated, representing fabulous wealth; yet scarcely any perceptible impression has been made upon the mass. The ore is very rich, yielding about 66 per cent. of pure iron. A number of furnaces are in operation in the vicinity of Marquette, which yield considerable pig iron; others of still greater capacity are being built, and mills for its further manipulation and manufacture are springing up on every side.

Perhaps a better idea of the mineral wealth of this country may be formed by an acquaintance with the quantity and valuation of iron and ore shipped up to the 10th of August, 1867, and estimated quantity to the close of navigation.

Receipts as above, tons ore, 166,497; pig iron, 15,198. Estimated receipts from August 10 to close of navigation, tons ore, 105,000; pig iron, 6,000. Total from Marquette for 1867, 171,497 tons ore, and pig iron, 21,198.

VALUATION.

171,497 tons ore, at $5	$857, 485
21,198 tons charcoal pig iron, at $40	847, 920
Total	1, 705, 405

To this must be added the value of iron and ore shipped on estimated quantity for 1867, which is $1,165,000, or a grand total for the county of Marquette of $3,370,405.

Appreciating the necessity of a good harbor at this point, Colonel W. F. Raynolds, United States engineers, made an examination of this harbor with a view to its improvement, and upon his estimates, $85,000 were appropriated by the thirty-ninth Congress for this purpose.

The plan of improvement proposed is to build a breakwater some two hundred feet in length in front of the town, this breakwater to be composed of cribs filled with ballast stone, and built upon either of the lines indicated in the charts accompanying Colonel Raynolds's report.

The charge of this harbor was not transferred to this department until late in the spring of this year, which left but little hope of accomplishing much this season. The work was advertised, however, and the bids opened and work awarded on the 20th of June. (For an abstract of bids see appendix.)

The persons to whom the award was made, and the nature of their contracts, I have also appended. The point nearest the light-house of the two proposed was selected and work commenced as soon after the letting as possible, and has progressed satisfactorily, there being three cribs placed up to the present time, and without doubt, before the close of the season, one hundred and sixty lineal feet of this breakwater will be completed.

During the ensuing season I apprehend that five hundred and ten running feet may be added to this; this will cost, at present contract prices, $43,150 32. It is proposed by the contractors for framing to continue the work during the winter as the timber is delivered; if this course is pursued, one hundred feet more, costing $22,490 16, may be added to the above.

That this amount can be most advantageously expended in the further extension of the work already begun, I think is without question, since the location is such that any expenditures for this purpose will be of incalculable benefit to Lake Superior commerce and navigation.

Very respectfully, your obedient servant,

JAMES B. QUINN,
Lieutenant U. S. Engineers.

Major and Brevet Colonel J. B. WHEELER,
Corps of Engineers.

Abstract of bids received and opened June 20, 1867, for improving harbor at Marquette, Michigan.

No.	Name of bidder.	Residence.	1st class.—Timber.			2d class.—Iron.		3d class.—Filling.		4th class.—Framing.	Remarks.
			Pine.	Plank.	Piles.	Bolts.	Spikes.	Stone.	Brush.		
				Per M.	*Cents.*	*Per lb.*	*Per lb.*			*Per l. f.*	
1	R. Nelson Gere	Syracuse				$0 05⅛	7½c.				
2	William Smith and William Nichols	Detroit	$0 25	$18 00	12	6 75	9	$9 00 per cord.	$1 00 per c. y'd.	9c.	$4 for each pile driven.
3	Irvin B. Laughlin	Pittsburg				5⅛	8				
4	James Gayner	Milwaukee	21			11	11	2 50 per c. y'd.	2 00 per c. y'd.	25	No guarantee.
5	Ledlie & Corse	Chicago	23⅜	19 90	19	5 87	14⅜	2 49 "	6 99 per cord.	18⅜	19 c. per lineal for dri'g piles.
6	Wm. Ferguson	Marquette	14⅛	16 00		5¼	7	1 25 "	1 25 per c. y'd.	12	
7	R. P. Hineman	Green Bay	15 90 per M.	18 00		7	7	2 37½ "	3 00 per cord.	20	
8	A. R. Harlon	Marquette	19⅜	18 00							
9	Peter White	do				4⅞	4⅞				
10	Ball & Biglow	do	18	16 00							
11	David Smoke	do	22					11 00	3 00 per cord.	25¼	
12	Timothy & Harly	do						2 00	50 per c. y'd.	17	Unsigned.
13	George & James Freeman	do						1 69 per c. y'd.	1 25		
14	Chapin & Wells	Chicago				5¼	8				
15	S. S. Vaughn	Bayfield	17 9-10	14 00							
16	Gelley & Weston	Milwaukee	28	18 00	10	6¼	6¼	11 70 per cord.	8 00 per cord.	10 7-10	
17	R. A. Connelly	Chicago	26	22 00	14	10	11	4 00 per c. y'd.	1 00 "	15	

Abstract of contracts for improving Marquette harbor, Michigan.

Contractors.	Nature of contracts.	Price.
William Ferguson	12-inch square pine timber per lineal foot	\$0 14$\frac{1}{8}$
William Ferguson	Stone per cubic yard	1 25
William Ferguson	Brush per cubic yard	1 25
William Ferguson	Plank per M	16 00
Peter White	Iron bolts per pound	0 04$\frac{7}{8}$
Peter White	6-inch wrought-iron spikes per pound	0 04$\frac{7}{8}$
Gelley & Weston	Framing per lineal foot	0 10$\frac{7}{10}$

Abstract of materials received and used, labor performed, and amount paid to contractor up to September 1, 1867, *at harbor of Marquette, Michigan.*

Contractor: Peter White. Material received: 20,200 pounds of iron. Materials used: 4,296 feet pine timber; 17 cubic yards stone; 500 pounds iron. Labor performed: 4,296 feet framing. Amount paid to Peter White, contractor, for iron: $984 75.

A 4.

MILWAUKEE, WISCONSIN, *August* 31, 1867.

SIR: In obedience to your instructions, embodied in circular of 20th ultimo, I have the honor to submit the following report upon Green bay, Wisconsin:

This harbor is situated at the mouth of the Fox river, and takes its name from the bay into which the river empties. The towns of Green Bay and Fort Howard are situated upon it, and are rapidly increasing in wealth and population; being situated at the head of Green bay, and in direct communication with the interior of the State, both by railroad and water, the trade of the northern and northwestern portions of Wisconsin naturally accumulates at these points. The harbor is deep and spacious, and protected from all violent winds and storms; and it is only necessary, therefore, to render this harbor accessible to all vessels from Green bay, in order to confer a great benefit upon the industry of the country and commerce of the lakes. With this object in view, the present course of improvement was proposed and adopted.

An appropriation for the improvement of this harbor was made in 1866, of $30,500, and during the second session of the thirty-ninth Congress a further appropriation of $15,500. Of this there has been expended up to the present time (see abstract appended) $12,447 25 in dredging out the channel between Grass island and the mouth of Fox river, and in opening cut across Grass island. The work of improving this entrance was begun late in October, 1866, but owing to the inclemency of the weather and accidents to machinery of the dredge, very little was accomplished, the whole quantity of earth removed being only 1,298.5 cubic yards; work was renewed in June, 1867, on the south side of Grass island in seven feet of water, distant from the island about two hundred yards, and has progressed favorably, there having been removed, up to the present time, thirty-two thousand two hundred and ninety-four yards of earth, and it is probable that by the close of the working season a channel twelve feet deep and one hundred feet wide will be made, extending from the twelve feet water on the south side of Grass island, to the twelve feet channel on the north. Already a strong current begins to flow through the cut, and I apprehend considerable earth may be removed from the channel by the freshets of the ensuing fall and spring. In order to observe the abrasive effect of these freshets, and the storms of winter, no protection for the sides of the channel has been provided. During the ensuing summer, however, the dredging will be sufficiently advanced to require this protection to be commenced, if not completed.

In my last report upon the improvement of this harbor (see Appendix to Chief of Engineers' report for the year 1866) I recommended a system of sheet piling for the protection of the sides of the channel, constructed in accordance with plans proposed by Colonel J. D. Graham, and costing, when completed, $55,416 77. Upon more mature consideration I am convinced that although this plan possesses the properties of stringent economy in first construction, it does not possess sufficient stability to withstand the violence of tempests, the rush of water during the period of freshets, or the pressure of sand from the exterior for any length of time; and it is, therefore, a question whether this, from its frailty, must certainly be continually undergoing expensive repairs, would prove as economical, in fact, as a structure which, though costing more to build, possesses the quality of permanency. In view of the very great importance which exists of giving to the work already begun as great a degree of durability as possible, with the least possible expenditure, I am persuaded to recommend the substitution of a system of close piling for seven thousand two hundred and thirty-six feet of the sheet piling, and cribs, twenty feet. wide, filled with stone, for the remaining three thousand six hundred and sixty-four feet; one crib to be placed at the end of each pier on the southern extremity, and the remainder to be placed upon the northern extremity. The close piling to be constructed by driving piles in juxtaposition next to the water-way; at a distance of twelve feet behind this, a second row, at distances apart of twelve feet; the two rows to be properly capped, bolted, clamped by string pieces, and connected by ties every twelve feet. This will cost (see estimate marked A) $130,947 87; the cribs to be of the plan followed in the harbor improvements of Lake Michigan. The cost of the ninety-two cribs of this description used will be (see estimate B) $184,579 60. Total for the entire protection, $215,527 47.

During the ensuing year the whole of this close piling and four cribs at least may be built, and, provided no unforeseen circumstances occur to prevent, fifty thousand yards of earth be removed; therefore, $161,000 may be profitably expended during the year 1868. Although this is a large sum, we cannot consider it as exorbitant in comparison with the immense benefit that must result from the completion of this work.

In the present condition of the entrance a vessel can get out of Chicago harbor loaded with one hundred tons more freight than it can from this; and by reason of its tortuousness, it is entirely inaccessible by night, and dangerous at all times.

Notwithstanding the many disadvantages of difficult entrance to harbor and the almost total failure of the harvest during the past three years, the trade of Green Bay has steadily increased. Perhaps some idea may be obtained of this increase by comparing the number and tonnage of vessels arriving and departing last year, and those of this:

This year's arrivals, 677 vessels; tonnage	139, 608
Last year's arrivals, 557 vessels; tonnage	108, 608
This year's departures, 673 vessels; tonnage	140, 250
Last year's departures, 573 vessels; tonnage	107, 200

There are some fifty vessels sailing from this port this year, the tonnage of which I am unable to ascertain. Ten steamers ply between this port and points on Green bay, whose tonnage aggregates 3,468 tons; and a number engaged in the navigation of the Fox river, the tonnage of which amounts to upwards of 1,000 tons.

I append an abstract of some of the most important imports and exports, a camparison of which with that of last year shows a considerable increase.

Green bay is in the collection district of Milwaukee, and is the port of entry for this harbor. The amount of revenue collected during the past year was not ascertained. The nearest light-house is called Long-tail Point light. The light is a fixed white light of the fourth order.

In contemplation of the easier access to Green bay that the present improvement will allow, when completed, vessel owners are calculating upon receiving the freight of Minnesota and northwestern Wisconsin entirely at this port, instead of receiving a large portion of it at Milwaukee and Chicago, as at present. In consequence of the crooked channel, and the difficulty and expense of navigating it, it costs from three cents to four cents per bushel more to ship wheat from this port to the same ports eastward.

Improvements are in progress upon the Green Bay and Mississippi canal that will soon place this port in excellent water communication with the Mississippi river; when this is completed Green Bay will become the principal shipping point for the surplus millions of bushels of wheat of Minnesota, Dakota, and northern Wisconsin; and, in return, of the machinery and tools of agriculture, goods, furniture, iron, nails, salt, and all the articles of merchandise needed in the country drained by the Fox and Wisconsin rivers, and that of the upper Mississippi, since freights from these places to Buffalo can be shipped by this route cheaper than by any route in operation or projected.

I have herein endeavored to present a few of the leading inducements for the continuation of the work of improvement already begun. If anything further concerning the position and character of the work is required, I respectfully refer to my preceding report of November 29, 1866.

I am, sir, very respectfully, your obedient servant,

JAMES B. QUINN,
Lieutenant United States Engineers.

Brevet Colonel J. B. WHEELER,
Major Corps of Engineers.

A.—*Estimate of cost of close piling necessary to protect the sides of the cut across Grass island.*

For 235,350 lineal feet of white oak piles, at 18 cents per foot....	$42, 363 00
For 14,472 lineal feet of 12-inch square timber, for caps, at 20 cents per lineal foot....	2, 894 40
For 21,708 lineal feet of 6×12-inch timber, for stringers, at 10 cents per lineal foot....	2, 170 80
For 7,891 lineal feet of 12-inch square timber, for ties, at 20 cents per lineal foot....	1, 578 20
For 101,017 lbs. of wrought iron bolts, at 6 cents per lb....	6, 061 02
For 19,666 cubic yards of brush or slabs, for filling, at $1 25 per yard....	24, 583 00
For 6,432 cubic yards of stone, for ballast, at $3 per yard....	19, 296 00
For framing 44,071 lineal feet of timber, at 10 cents per foot....	4, 407 10
For driving 7,845 piles, at $2 per pile....	15, 690 00
	119, 043 52
Contingencies, at 10 per cent....	11, 904 35
Estimated cost of close piling....	130, 947 87

B.—*Estimated cost of one crib* 20′×32′×17′, *constructed according to plan adopted by Major J. B. Wheeler, U. S. Engineers.*

For 2, 368 lineal feet of 12-inch square timber, at 20 cents per lineal foot	$473 60
For 3,554 lbs. wrought iron bolts, at 6 cents per lb	213, 24
For 265½ cubic yards of stone, at $3	796 50
For 32 cubic yards of brush or slabs, at $1 25 per yard	40 00
For 288′ B. M. 3-inch planks, at $20 per M	5 76
For 6 lbs. 6-inch wrought iron spikes, at 10 cents	60
For framing 2,368 lineal feet of timber, at 20 cents per lineal foot	473 60
	2, 006 30
Contingencies, at 10 per cent	200 63
Estimated cost of one crib	2, 206 93
Estimated cost of 92 cribs	184, 579 60
Cost of close piling	130, 947 87
Estimated cost of protection	215, 527 47

Abstract of imports and exports of Green Bay, Wisconsin, for the year ending July 31, 1867.

IMPORTS.

Articles.	Quantity.	Articles.	Quantity.
Tea, chests	400	Oil, pounds	2, 307
Tobacco, packages	600	Drugs, packages	1, 876
Fruit, packages	1, 045	Coal, tons	700
Crackers, pounds	505	Pig iron, tons	400
Salt, pounds	11, 505	Sirup, barrels	300
Barley malt, bushels	1, 500	Sugar, barrels	500
Stoves	2, 835	Molasses, hogsheads	50
Horse-rakes	264	General merchandise, tons	7, 500
Nails, kegs	4, 064		

EXPORTS.

Flour, barrels	114, 500	Hides	6, 000
Wheat, bushels	303, 313	Wool, bales	753
Corn, bushels	65, 000	Cattle	3, 740
Oats, bushels	365, 915	Sheep	1, 580
Beef and pork, barrels	4, 600	Pelts	2, 000
Potatoes, bushels	7, 132	Hay, bales	4, 576
Beans, barrels	11, 627	Pearlash, casks	300
Rye, bushels	8, 000	Railroad cars	120
Butter, firkins	12, 182	Railroad ties	100, 000
Eggs, barrels	335	Shingles	200, 000, 000
Meal and feed, bags	200, 000	Lumber, feet	40, 640, 000
Hops, bales	93	Laths	5, 000, 000
Fish, packages	15, 227	Staves and headings, sets	10, 384
Beer and ale, kegs	5, 120	Felloes, sets	5, 485
Baskets	1, 973	Brick	1, 305, 000

Abstract of labor performed and amount paid to contractor up to September 1, 1867, at harbor of Green Bay, Wisconsin.

Labor, 32,294 yards of dredging. Paid William S. Smith, contractor, $12,447 25.

A 5.

MILWAUKEE, WISCONSIN, *August* 31, 1867.

SIR: The subjoined report upon the present and prospective condition of the harbor of Manitowoc, Wisconsin, is respectfully submitted in compliance with your instructions of July 20, 1867. Manitowoc, Wisconsin, is situated at the mouth of the Manitowoc river, which empties into a beautiful bay on Lake Michigan, of some six miles in length, and two and a half miles in width; excellent anchorage is found in this bay, and partial protection from the fierceness of northeast and southeastern gales. During the spring freshets, a large volume of water is projected into the lake by the Manitowoc river, sufficient to maintain an adequate depth of water at its mouth, were it confined to a straight and uninterrupted course to the deep water of the lake.

As a refuge, the existence of a good harbor at this point is patent; it is the most northern harbor upon the west shore of Lake Michigan upon which any improvement by the United States has been made. It is twenty-five miles north of Sheboygan, and eighty-five miles south of Manitou islands, and is the only harbor intermediate, in which vessels can seek refuge in tempestuous weather. The safety, therefore, of the lake navigation calls loudly for the completion of the works already begun.

Congress, during the thirty-ninth session, appropriated $45,000, in addition to the $52,000 existing for the improvement of this harbor. The plan of improvement proposed was to construct piers on each side of the river's mouth, extending in a parallel direction to the deep water of the lake; this required the construction of 2,150 feet of pier work, and, in order to secure twelve feet depth of water between them, the removal of 57,677 cubic yards of earth.

The work of improvement was begun early in June of this year, and has progressed satisfactorily up to the present time. Mr. David Smoke, the contractor for furnishing material, and framing, placing, and sinking cribs, has constructed and placed in position sixteen cribs on the north side; the superstructure has been already commenced, and, if hindrances do not occur, will shortly be completed as far as the cribs extend; further additions will be made this fall. The harbor commissioners (the contractors for dredging) have removed up to the present time 13,955 cubic yards of earth, and the probabilities are, that from 8,000 to 10,000 cubic yards may be removed between this and the close of the working season.

There may be, according to the present contracted prices for timber, iron, labor, and dredging, $55,000 profitably expended in the extension of these cribs and dredging between them during the ensuing year.

The present depth of water is such that vessels drawing over five and a half feet of water cannot enter; when once across the bar that obstructs the mouth of the river, ample depth of water to meet the usual requirements of vessels sailing upon Lake Michigan is obtained.

Notwithstanding the shallowness and tortuousness of the channel from the river to the lake, during the past year the exports and imports of this place have steadily increased; and the commercial lumbering, ship-building, and agricultural interest of that portion of Wisconsin which finds an egress at this point have rapidly increased in wealth and importance.

Perhaps some idea of this advancement may be obtained by an inspection of the number and tonnage of vessels sailing to and from this harbor during the past year: Arrivals, 685; tonnage, 149,894; departures, 689; tonnage, 151,590; tonnage on stocks at present, 1,300. A tabular statement of some of the most important exports I append.

A heavy expense is incurred in the loading of vessels with the more bulky of the articles exported, it being necessary to employ lighters for the purpose; whereas, were the entrance so improved as to admit vessels, lumber could be loaded directly from the mills, and staple produce of the tributary country from docks, instead of being transferred to lighters, or hauled to piers, where they are subjected to heavy percentage for pierage before they can be shipped.

This harbor is in the collection district of Milwaukee, the latter place being the port of entry. A light-house stands upon the bluff near the entrance; the light is a fixed white light of the fifth order.

Manitowoc and the surrounding country is still in its infancy; and a retrospective glance at its past history leads to a brilliant hope for the future; and we feel convinced that, if the present plan of improvement is pursued, inestimable benefit must result to not only the local interests of the place, but to the entire commerce and navigation of Lake Michigan.

Very respectfully, your obedient servant,

JAMES B. QUINN,
Lieutenant United States Engineers.

Brevet Colonel J. B. WHEELER,
Major Corps of Engineers.

Abstract of materials received and used, labor performed, and amount paid to contractors up to August 31, 1867, *at harbor of Manitowoc, Wisconsin.*

Contractors.	Materials received.						
	Pine timber.	Other timber.	Plank.	Piles.	Iron.	Stone.	Remarks.
	Feet.	*Feet.*	*B. m.*		*Pounds.*	*C. yds.*	
David Smoke	68,998	57,814				685	
Joseph Vilas					60,536		1,200 lbs. of spikes.
Hero & Packard			17,100				
John Scheath				1,890			

Materials used.				Labor performed.			
Timber.	Piles.	Stone.	Iron.	Dredging.	Framing.	Piles driven.	Cribs placed.
Feet. 48,380	*Feet.* 1,710	*Cub. y'ds.* 685	*Pounds.* 45,414	13,955	48,600	*Feet.* 1,710	*Feet.* 16

Contractors.	For what paid.	Amount paid.
David Smoke	Framing stone, timber; placing and sinking cribs	$32,555 82
Hero & Packard	Plank	356 80
John Scheath	Dredging	2,726 40
Joseph Vilas	Iron bolts and spikes	4,685 70
		40,324 72

Abstract of some of the principal articles exported from Manitowoc, Wisconsin, during past year.

Articles.	Quantity.	Articles.	Quantity.
Lumber ....feet..	8,912,000	Wheat ....bushels..	78,492
Shingles	59,328,000	Peas ....bushels..	2,170
Laths..................................	1,544,000	Flour.....................barrels..	2,160
Broom-handles	67,000	Leather ....rolls..	1,608
Posts..................................	46,400	Cattle	748
Staves	64,000	Butter ....pounds..	12,700
Pickets	170,000	Sundries..............packages..	14,407
Wood....................cords..	7,264	Fish ....half barrels..	1,887

A 6.

MILWAUKEE, WISCONSIN, *August* 31, 1867.

SIR: I have the honor to submit the subjoined report upon the harbor improvements, present and prospective, of Sheboygan, Wisconsin, in conformity with your instructions contained in circular of July 20, 1867.

This harbor is situated in the collection district of Milwaukee; the latter place being the nearest port of entry. Like the majority of the harbors upon Lake Michigan, this harbor consists of a portion of the mouth of the river of the same name, improved by artificial means.

The method of improving this harbor is the ordinary one pursued in similar places upon Lake Michigan—that of building piers on each side of the river, extending from the shore to the deep water of the lake, and dredging out between these piers in such a manner as to secure sufficient depth of water to permit vessels to pass into the river.

As to the vitality of the towns situated at, and the country tributary to, these commercial portals depends upon their efficiency, the maintenance of this egress in a serviceable condition is to them of the first importance; were, however, local interests alone benefited by the improvement of these harbor entrances, we might stop here and insist that private enterprise should make the necessary improvements; but when we turn our attention to the vast amount of shipping engaged in the commerce of Lake Michigan, and the severity of the gales upon this fresh-water sea, it becomes of the gravest importance that points should exist upon its shores in which vessels can find refuge during unfavorable weather.

Owing to the absence of any suitable bays on the coasts of this lake, the government is forced to improve the mouths of the largest rivers emptying into it; for when the bars generally formed at the mouths of these rivers are once passed sufficient depth and extent of water is found to answer all the requirements of a good harbor of refuge.

As there is at present no harbor existing between Milwaukee and the Manitou islands to which vessels can flee in stormy weather, the interests of the community at large, as well as local interests, called attention to the necessity of improvements being made at this point; and the government, following the policy that the safety and welfare of the people must be provided for, caused an examination and survey to be made, and appropriated in 1865 $47,000, and in 1866 $8,000 more, to perfect the improvements already commenced at the harbor of Sheboygan.

The plan of improvement proposed and approved was to extend the north pier one hundred and twenty feet, the south pier three hundred and twenty feet, and to dredge between the piers to a depth of twelve feet. Work was begun upon the harbor early in June of this year, and has progressed satisfactorily, under the circumstances up to the present time, and I apprehend, if no further accidents occur, the improvement will be completed by the close of the working season.

The existence of a bed of quicksand, upon which the cribs were necessarily placed, has occasioned considerable unforeseen expense and difficulty to retain the cribs in place and keep them ballasted properly since they were sunk. I think $2,000 will repair all deficiencies, however.

I caused a few lines of soundings to be taken in the prolongation of the new pier, and find that some few changes have occurred since the last survey, though not unexpected, there merely having been some slight accretion upon the bar off the entrance.

As the original plan was, I believe, to extend the piers to the curve of twelve feet water, it will be necessary to do this to extend the pier across this bar lying in front of the entrance; this will require an additional four hundred and sixteen feet of piering, as the pier will project some distance into the lake. I think it advisable to increase the width of the cribs, of which it would be composed, to twenty-five feet, as such cribs are more stable, on account of their extended base and increased weight.

To give a water way of twelve feet in depth between these piers, it will be necessary to remove, by dredging, fifteen hundred cubic yards of earth; this, added to the cost of piering and incidental expenses, gives $49,026 38 as the sum required to complete this extension. (See estimates.)

The completion of this extension will secure a safe and commodious harbor, with flattering prospects of remaining so for a number of years.

I am informed that vessels passing through the straits on their way to Chicago and Milwaukee, after leaving the Manitou islands, steer direct for the Sheboygan light-house; the probabilities are, therefore, that vessels passing to and fro between points south and the Manitou islands would naturally sail close to this point, and, in the event of stormy weather, would seek shelter in it.

During the past year 7,496 vessels passed the light-house. This light is situated on Sheboygan north-point, about one mile north of the harbor; it is a fixed white light of the fifth order. This light being situated north of the harbor, no account is kept of the number of vessels sailing between this port and points south, nor of the vessels passing in the night; so the number reported is rather incomplete.

During the past year there cleared from this port 1,114 vessels, the tonnage of which I have been unable to ascertain.

I append an abstract of some of the most important imports and exports, a comparison of which with that of preceding years will show a decided increase. These tables are interesting from the fact that, as the commerce of a place is the exponent of the thrift thereof, they will indicate with considerable accuracy the importance of this place, and, by comparison, the rapidly increasing producing qualities of the tributary country, which needs but the stimulus of a good harbor to ship from to make much more rapid strides in wealth and importance, and I therefore have no apprehension that any money that might be expended in the improvement of this harbor would not result in incalculable advantage to general as well as local interests.

I am, sir, very respectfully, your obedient servant,

JAMES B. QUINN,
Lieutenant United States Engineers.

Brevet Colonel J. B. Wheeler,
Major Corps of Engineers.

Abstract of some of the most important imports and exports at the harbor of Sheboygan, Wisconsin, for the year ending June 30, 1867.

IMPORTS.

Articles.	Quantity.	Articles.	Quantity.
Merchandise ....packages..	36,872	Apples and sundries..packages..	4,806
Lumber ....feet..	413,000	Bark......................cords..	197
Green hides	3,819	Iron..................bundles..	5,557
Nails...................kegs..	1,758	Salt ....barrels..	4,227
Coal.....................tons..	306	Corn..................bushels..	9,212
Oats.................bushels..	7,722		

EXPORTS.

Wood.....................cords..	2,416	Ashes...................casks..	83
Butter ....tubs..	3,370	Laths..........................	1,065,000
Flour.................barrels..	24,223	Chair stuff..........packages..	445
Wheat ....bushels..	173,769	Wooden shoes...........pairs..	2,000
Wool ....pounds..	110,281	Bricks	119,000
Eggs ....barrels..	488	Beer.................barrels..	541
Wagon stuff.........packages..	24,187	Lime ....barrels..	205
Packing ....barrels..	10,769	Hay ....tons..	46
Fish...................barrels..	861	Cheese ....pounds..	29,000
Cattle and sheep.........head..	1,374	Hogs ....head..	197
Peas ....bushels..	6,254	Sundries............packages..	13,242

Abstract of materials received and used, labor performed, and amount paid to contractors, up to September 1, 1867, *at harbor of Sheboygan, Wisconsin.*

Contractors.	MATERIALS RECEIVED.						
	Timber.		Plank.	Piles.	Stone.	Brush.	Iron.
	Pine.	Other.					
	Feet.	*Feet.*	*Feet.*	*Feet.*	*Cords.*	*Cords.*	*Lbs.*
Sanger, Ledlie & Corse	....	....	....	....	......	99	47,011
Dillingham & Co...............	11,428	17,021	3,716	1,830	......	......	......
Locklin & Jenkins	....	....	....	....	526¾	......	......

MATERIALS USED.				LABOR PERFORMED.			
Timber.	Piles.	Stone.	Iron.	Dredging.	Framing.	Piles driven.	Cribs placed.
Feet. 29,917	*Feet.* 840	*Cords.* 452	*Lbs.* 31,340	*Cub. yard.* 18,096	*Feet.* 29,917	28	13

Contractors.	For what paid.	Amount paid.
Sanger, Ledlie & Corse	Brush, iron, dredging, framing, and placing cribs and driving piles	$14,480 53
Dillingham & Co	Timber, plank scantling, and piles	6,820 37
Locklin & Jenkins	Stone	4,520 00

COST OF ONE CRIB 32′ × 25′ × 20′

Estimate.

Materials.	Quantity.	Rates paid.	Amount.
4 oak piles	120 running feet	16 cts. per r. foot	$19 20
12-inch square timber, oak	2,697 running feet	27 cts. per r. foot	728 19
12-inch square timber, pine	710 running feet	24 cts. per r. foot	170 40
3-inch plank	288 feet, board measure	$25 per M	7 20
Iron bolts	3,880.97 pounds	10 cts. per lb	388 09
Iron spikes	6 pounds	10 cts. per lb	60
Stone ballasting	89 cords	$10 per cord	890 00
Brush for intervals	10 cords	$6 per cord	60 00
Driving piles	120 running feet	19 cts. per lin'l foot	22 80
Framing	3,407 running feet	19 cts. per lin'l foot	681 40
Cost of material for one crib			2,966 88
Cost of material for thirteen cribs			38,569 44
Dredging 1,500 cubic yards, at 40 cents per cubic yard			6,000 00
			44,569 44
Contingencies of 10 per cent			4,456 94
Total cost of improvement			49 026 38

A 7.

MILWAUKEE, WISCONSIN, *September* 1, 1867.

COLONEL: I have the honor to submit the following report on Milwaukee harbor:

The harbor of Milwaukee, Wisconsin, is one of the best, and next to Chicago harbor, the most important on the west shore of Lake Michigan. From the formation of the shore it is well protected from some of the severest winds, and is not liable to be soon obstructed by the formation of a bar at its mouth. The freshets in the spring are also of service in helping to keep open the mouth of the harbor. The harbor was sounded in April of this year immediately before, and in June immediately after, the freshets, and the soundings show that the bar was moved considerably out into the lake.

The harbor is now in a good condition, the only work at present being done in the filling of the old cribs with stone; this work will be finished about the 15th of September.

The harbor can be further improved by extending each pier three hundred and twenty feet; this will probably be the only improvement necessary for many years, except the repairs needed on the old pier, and perhaps occasionally a little dredging.

This extension is necessary; for the bar, though forming slowly, will in course of time obstruct the entrance if nothing be done to prevent it, and if the work be delayed it will cost more when it is done, because the bar will have to be dredged away, thus incurring an expense not necessary now.

As the extension will in many places be in fourteen or fifteen feet of water, the cribs composing it will have to be thirty-two feet long, twenty-five feet wide, and twenty feet high.

The following is an estimate of the cost of one of such cribs, the prices taken are the same as the present contract prices at Racine, Wisconsin:

3,378 running feet of 12-inch square timber, at 24 cts	810 72
288 feet of 3-inch plank, at $30 per M	8 64
3,880 pounds of iron bolts, at 10 cts	388 00
6 pounds of iron spikes, at 10 cts	60
90 cords of stone, at $12 80	1,152 00
10 cords of brush, at $6	60 00
3,378 feet of framing, at 17 cts	574 26
	2,994 22
Add 10 per cent. for contingencies	299 42
	3,293 64

As the extension will consist of twenty cribs, the whole cost will be $65,872 80.

The following information was obtained from Mr. C. L. Sholes, collector at this port:

Customs collected during the year ending June 30, 1867, $83,815 19.

All customs for this district are paid at Milwaukee.

Amount of exports during same time	$750,901
Amount of imports during same time	75,990
Number of vessels arrived	3,761
Number of vessels cleared	3,687

The business of this, as well as of all other ports in the district, is rapidly and uniformly on the increase.

The amount collected in duties is no particular indication of the importance of a place or port, as many places of much less importance generally than Milwaukee collect much more duties.

The light-house is located at the north point of Milwaukee bay, in latitude, north, 43° 02′ 24″, longitude, west, 87° 54′ 08.″ The light is fixed, varied by flashes at intervals of two minutes, and is visible fourteen nautical miles. The color of the tower is yellow, and its height is twenty-eight feet; height of light above sea level, one hundred and two feet; the lens is of the fourth order; the light-house was built in 1855.

North-cut beacon is situated at the extreme end of North harbor pier, in latitude, north, 43° 01′ 37″, longitude, west, 87° 53′ 59″. The fog signal is a horn; the light is a fixed red one, and is visible eight nautical miles; the height of the tower is thirty-six feet, and height of light above sea level, forty-eight feet; the lens is of the sixth order.

Annexed is a tabular statement of work done and material received; also, abstract of contracts and abstract of bids.

Very respectfully,

D. B. HEAP, *Captain of Engineers.*

Major and Brevet Col. J. B. WHEELER,
Corps of Engineers.

Abstract of contract for improving Milwaukee harbor, Wisconsin.

Contractor.	Nature of contract.	Price.
Valentine Kuhlman	Stone, per cubic yard	$2 70

Abstract of materials received and used, labor performed, and amount paid to contractors, up to the 1*st of September,* 1867, *at harbor of Milwaukee, Wisconsin.*

Contractors.	Stone received.	For what paid.	Amount paid.	Remarks.
	Cubic yds.			
V. Kuhlman	3,327	Stone	$8,601 74	All the stone has been put in the cribs that has been received.

The following is an abstract of the bids opened on June 27, 1867, for furnishing the stone at Milwaukee:

1. Thos. Duffy, to furnish the stone and fill the cribs at $2 80 per cubic yard.
2. Hasbrouck & Conro, to furnish the stone and fill the cribs at $13 per cord.
3. Hunt & Rassiter, to furnish the stone and fill the cribs at $2 85 per cubic yard.
4. J. D. Dolan, to furnish the stone and fill the cribs at $2 73 per cubic yard.
5. V. Kuhlman, to furnish the stone and fill the cribs at $2 70 per cubic yard

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A 8.

MILWAUKEE, WISCONSIN, *September* 1, 1867.

COLONEL: I have the honor to submit the following report of the harbor of Racine, Wisconsin:

This harbor, situated at the mouth of Root river, is of considerable importance. Racine being next in importance and wealth to Milwaukee, and a considerable amount of trade passing through it, makes it necessary to keep the harbor in a state of thorough repair.

In August, 1866, there was a contract made to dredge out the harbor to a depth of twelve feet; this has been nearly completed; at the same time there was a contract made to construct two hundred and fifty-six feet of pier work, which was placed on the end of the south pier, and is now nearly completed, all the cribs being sunk, and the superstructure only to be finished.

On June 27, 1867, a contract was let to construct four hundred and sixteen feet of pier work. It is the intention to add this to the north pier. If this be done, the south pier should be extended an equal length, then both piers will reach water twenty feet deep, and the harbor will not probably need any additional improvement of magnitude for years.

The cribs composing this extension should be thirty-two feet long, twenty-five feet wide, and average twenty feet high.

Such a crib will cost as follows:

3,378 running feet of 12-inch square timber, at 24 cts.	$810 72
3,378 running feet of framing, at 17 cts	574 26
288 feet of 3-inch plank, at $30 per M	8 64
3,880 pounds of iron bolts, at 10 cts. per pound	388 00

6 pounds of iron spikes, at 10 cts. per pound	60
90 cords of stone, at $12 80 per cord	1,152 00
10 cords of brush, at $6	60 00
	2,994 22
Add per cent. for contingencies	299 42
	3,293 64

Thirteen cribs will then cost $42,817 32.

There is a sunken reef about three miles from shore, on which it would be advisable to build a light-house as a protection to shipping.

Annexed is a report of the exports and imports; abstracts of the contracts of August, 1866, and June, 1867; abstract of bids in June, 1867; and tabular statement of work done and paid for, and material received, up to 1st September.

Very respectfully, your obedient servant,

D. B. HEAP, *Captain of Engineers.*

Major and Brevet Col. J. B. WHEELER,
Corps of Engineers.

Racine is situated in district of Milwaukee, and is itself a port of entry. There is a fixed white light in the light-house; the lens is of the fifth order, and shows at an elevation of forty-seven and a half feet above the lake, (less lake rise since 1866.) The following are the imports and exports in the year 1867:

IMPORTS.

Lumber, feet B. M	25,805,600	Tons of coal	11,452
Laths, number	2,090,000	Tons of pig iron	530
Shingles, number	6,236,000	Barrels of salt	28,572
Cedar posts, number	66,050	Barrels of water lime	1,400
Railroad ties, number	22,713	Staves	5,525
Cords of wood	1,520	Kegs of powder	200
Cords of bark	2,262	Boxes peaches	950
Cords of bolts	423	Barrels apples	388
Piles	3,600	Telegraph poles	400
Cords cut stone	200	Packages merchandise	11,156
Cords rough stone	40	Hoops	14,000

Five hundred and thirty-two sailing vessels arrived at, and five hundred and sixty cleared from, Racine. Forty-two steam vessels arrived and cleared. Two and three steamboats per day stop at Racine during eight months of the year.

The revenue collected at Racine is for entrance and clearance dues. It amounted to $584 75 during 1866; and from 1st January, 1867, to 1st July, 1867, to $176.

The exports are as follows:

Bushels wheat	841,759	Tons scrap iron	145
Bushels corn	555,981	Barrels corn meal	2,300
Bushels oats	560,739	Sacks wool	287
Barrels flour	17,310	Barrels lime	150
Barrels beef	155	Barrels salt	185
Tons hay	694	Barrels	5,107
Tons mill-feed	147	Bricks	135,500

The following is the abstract of bids for the work at Racine, which was let on 27th June, 1867:

1. Hunt & Rassiter, Milwaukee.—Stone, $2 72 per cubic yard; brush, $1 24 per cubic yard; framing, 17 cents per lineal foot.

2. Ledlie & Corse.—12-inch square timber, 21½ cents per lineal foot; pine plank, $20 per M.; iron 5 4-10 cents per pound; spikes, 12 cents per pound; stone, $2 69 per cubic yard; brush, $5 40 per cord; framing, 10 cents per foot; sinking and filling cribs, $110 each crib; delivering piles, 19 cents per lineal foot; driving piles, 17 cents per lineal foot.

3. Patrick M. Danaher, of Ludington, Michigan.—12-inch square timber, $14 97 per M.; plank, $14 97 per M.; stone, $14 90 per cord; iron bolts, 5⅞ cents per pound; framing, 13¾ cents per lineal foot.

4. R. Nelson Gere, of Syracuse, New York.—Iron bolts, 5 cents per pound; iron spikes, 7 cents per pound.

5. M. V. Thompson, of Geddes, Onondaga county, New York.—Iron bolts, 4⅞ cents per pound; iron spikes, 7 cents per pound.

Remarks.—Mr. Thompson's bid was rejected as informal, he furnishing no guarantee.

Abstract of contracts for improving the harbor at Racine, Wisconsin.

CONTRACTS OF AUGUST, 1866.

Contractors.	Nature of contract.	Price.
James V. Sanger	White oak piles, per lineal foot	$0 19
James H. Ledlie	Plank per thousand, board measure, 3-inch	30 00
John M. Corse	Scantling per thousand, board measure	30 00
	Square timber, 12-inches, per lineal foot	24
	Iron bolts and spikes, per lb	10
	Brush in cribs, per cord	6 00
	Stone in cribs, per cord	13 89
	Placing cribs each	39 00
	Driving piles, per lineal foot	19
	Framing, per lineal foot	16
	Dredging, per cubic yard	49

Repairs to be paid for at rates fixed by engineer officer in charge.

CONTRACTS OF JUNE, 1867.

Contractors.	Nature of contracts.	Price.
P. M. Danaher	12-inch square timber per M, b. m	$14 97
P. M. Danaher	3-inch plank per M, b. m	14 97
P. M. Danaher	Framing per lineal foot of timber	13¾
Ledlie & Corse	Stone per cubic yard	2 69
Ledlie & Corse	Brush per cord	5 40
R. Nelson Gore	Iron bolts per pound	5
R. Nelson Gore	Iron spikes per pound	7

Abstract of materials received and used, labor performed, and amount paid to contractors up to September 1, 1867, *at harbor of Racine, Wisconsin.*

Contractors.	Material received.				
	Pine timber.	Piles.	Stone.	Brush.	Iron.
	Feet.	*No.*	*Cords.*	*Cords.*	*Pounds.*
Sanger, Ledlie & Corse	20,857	11	629	139	27,316

Materials used.				Labor performed.		
Pine timber.	Piles.	Stone.	Iron.	Dredging.	Framing.	Cribs placed.
Feet.	*No.*	*Cords.*	*Pounds.*	*Cub. yards.*	*Lineal feet.*	
20,857	11=330 feet.	240	18,000	5,962	13,129	8

Contractors.	For what paid.	Amount paid.
James V. Sanger James H. Ledlie John M. Corse	Iron, timber, stone, brush, dredging, and framing	$20,617 93

A 9.

MILWAUKEE, WISCONSIN, *September* 1, 1867.

COLONEL: I have the honor to submit the following report on Kenosha harbor, Wisconsin.

This harbor, situated on the west shore of Lake Michigan, about twelve miles south of Racine, is of considerable importance, as will be seen by referring to the annexed table of imports and exports.

The present improvement consists in dredging out the channel to a depth of twelve feet, and in extending the north pier one hundred and ninety-two feet, and the south pier three hundred and fifty-two feet, which carries the end of each pier into twelve feet water.

I would recommend that each pier be further extended two hundred and twenty-four feet, carrying the ends of the piers into about twenty feet water. This extension will take fourteen cribs; eight of these cribs should be thirty-two feet long, twenty feet wide, and average twenty feet high; the remaining six should be thirty-two feet long, twenty-five feet wide, and average twenty-five feet high. The cost for one of each of these cribs is as follows:

Crib 32′ × 20′ × 20′:

2,760 feet of 12-inch square timber, at 29 cents	$802 40
288 feet plank, at $30 per thousand	8 64
4,074 pounds of bolts, at 10 cents	407 40
6 pounds of spikes, at 10 cents	60

315 cubic yards of stone, at $2 72	$856 80
40 cubic yards of brush, at $1 05	42 00
2,760 running feet of framing, at 17 cents	469 20
	2,587 04
Add 10 per cent. for contingencies	258 70
	2,845 74
Cost of eight cribs	$22,765 92

Crib 32′ × 25′ × 25′:

4,159 running feet of timber, at 24 cents	$998 16
288 feet of plank, at $30 per thousand	8 64
4,762 pounds of iron bolts, at 10 cents	476 20
6 pounds of iron spikes, at 10 cents	60
112 cords of stone, at $13 87	1,553 44
13 cords of brush, at $5	65 00
4,159 running feet of framing, at 17 cents	707 03
	3,809 07
Add 10 per cent. for contingencies	380 90
	4,189 97
Cost of six cribs	$25,139 82
Add cost of eight cribs	22,765 92
Whole cost	47,905 74

It is not probable that any dredging will be necessary next year, but the old south pier is very much in need of repair, and it will cost about $20,000 to put it in good order; it is 1,200 feet long.

The following is a copy of a letter from the deputy collector at Kenosha:

Kenosha is in the district of Milwaukee.

The nearest port of entry is Racine.

One hundred and fourteen vessels arrived during the year 1866; 115 vessels cleared during the year 1866; 125 vessels arrived during the year 1867, to July 1; 121 vessels cleared during the year 1867, to July 1.

The fees collected for year 1866 were	$136 75
The fees collected for year 1867, to July 1, were	124 50
Tonnage duties for the year 1867, to July 1, were	222 57
	347 07

The imports for 1866 were 4,358,000 feet lumber, 160,000 laths, 7,400 posts, 1,429,000 shingles, 760 cords of wood, 9,500 bushels barley, 278 cords bark, 705 tons of coal, 100 cords stone.

The exports for 1866 were 16 barrels lime, 3 barrels beans, 500 dozen eggs, 1,000 pounds cheese, 500 pounds butter, 100 barrels beef.

The imports for six months ending July 1, 1867, were 7,299 bushels barley, 2,712 cords wood, 11,500 posts, 204,000 laths, 37,000 staves, 3,210,000 feet lumber, 12 barrels flour, 200 barrels maple sugar, 153 cords tan bark, 365 cords stone, 5 tons hay, 218,000 feet timber.

Exports for six months ending July 1, 1867, were 81,000 feet lumber, 267½ tons hay, 49 wagons, 1 cutter, 2 tons coal, 1 dozen brooms, 14 barrels eggs, 2,077 pounds butter, 897 bushels potatoes, 3 barrels pork, 46 sacks feed, 37 bags oats, 10 tons castings, 1,780 barrels flour, 300 bushels oats, 10 pounds cheese.

The goods received and discharged by steamer at the pier were not included in the above report.

E. SIMMONS, *Deputy Collector.*

Annexed there is a tabular statement of work done and material received up to 31st August; also an abstract of contract for improving the harbor.

Very respectfully your obedient servant,

D. P. HEAP, *Captain of Engineers.*

Major and Brevet Col. J. B. WHEELER,
Corps of Engineers.

Abstract of contract for improving the harbor of Kenosha, Wisconsin.

Contractor.	Nature of contract.	Price.
James V. Sanger	Piles, per lineal foot	$0 19
James H. Ledlie	Oak plank, per M, (b. m.)	25 00
John M Corse	Pine plank, per M, (b. m.)	30 00
Do	Scantling, per M, (b. m.)	30 00
Do	12-inch square timber, pine, per lineal foot	29
Do	12-inch square timber, oak, per lineal foot	39
Do	Iron bolts and spikes, per pound	10
Do	Brush in cribs, per cord	5 00
Do	Stone in cribs, per cord	13 87
Do	Driving piles, per lineal foot	13
Do	Framing, per lineal foot	10
Do	Placing cribs, each	39 00
	Repairs, to be paid for at rates fixed by engineer officer in charge.	
Caleb H. Parker	For dredging between piers, and for foundation for cribs, per cubic yard	37
Do	Dredging on bars or points outside of proposed extension	74

Abstract of material received and used, labor performed, and amount paid to contractors up to September 1, 1867, at harbor of Kenosha, Wisconsin.

Contractors.	Materials received.			
	Timber.	Stone.	Brush.	Iron.
	Feet.	*Cords.*	*Cords.*	*Pounds.*
James V. Sanger James H. Ledlie John M. Corse	27,678	910	120	53,827

Materials used.			Labor performed.		
Timber.	Stone.	Iron.	Dredging.	Framing.	Cribs placed.
Feet.	*Cords.*	*Pounds.*	*Cubic yards.*	*Feet.*	
15,460	330	26,000	40,050	15,460	11

Contractors.	For what paid.	Am't paid.
Caleb H. Parker	Dredging	$13,199 75
James V. Sanger James H. Ledlie John M. Corse	Timber, framing, brush, stone, and iron	22,772 44
Total		35,972 19

A 10.

MILWAUKEE, WISCONSIN, *September* 1, 1867.

COLONEL: I have the honor to respectfully submit the following report on Chicago harbor.

The government has made no recent surveys of this harbor.

In August, 1866, a contract was made to extend the north pier six hundred feet. The work was not commenced until this year.

While Lieutenant Colonel J. D. Graham was in charge of the harbor improvements of this lake, the Chicago Dock and Canal Company had the privilege granted them from the War Department "to make an opening through the United States north pier, to communicate from this harbor with ship basins and canals, which the said company propose to construct within certain grounds owned by it, immediately north of and adjacent to said pier."

Since then this company has greatly enlarged its plans, and intend constructing a much larger basin. To save the expense of cutting through the old pier, they applied for and obtained permission to have an opening of three hundred feet left when the new government extension was built.

This new extension will now commence at a point three hundred feet distant from the old pier and on a line with it, and then will run due east for a distance of six hundred feet.

The Chicago Dock and Canal Company are required to enclose their basin sufficiently this year to protect this opening from the action of the wind and waves, and there was also an agreement entered into with them by which they assume any extra expense that the contractors may incur, by commencing the extension at the point referred to instead of at the end of the old pier.

This arrangement is advantageous to the government, for it virtually extends the pier nine hundred instead of six hundred feet; the crib-work enclosing the basin effectually preventing any wash through the opening from the north, the direction of all the severe winds, and where the drifting sand and gravel come from.

This extension reaches water twenty-four feet deep, a depth at which the bottom is not appreciably affected by the action of the waves. I do not believe that any bar will be formed at the end of this pier for many years.

There is no necessity for building a south pier. In the first place the entrance to the harbor is none too large now, and a south pier would cramp it still more; and in the second place it would be useless, as the citizens of Chicago have induced Lake Michigan to run into the Chicago river; consequently the river current will not be of the slightest use in removing obstructions at the entrance.

I append the report of the collector, an abstract of the contracts, and a tabular statement of material used and work done up to date.

Very respectfully,

D. P. HEAP, *Corps of Engineers.*

Major and Brevet Col. J. B. WHEELER,
Corps of Engineers.

The following is information concerning Chicago, obtained from Mr. Walker B. Scates, the collector at that port:

Chicago light-house.—Official number of light-houses on the northern and northwestern lakes, No. 68; 41° 53′ 25″ latitude north, 87° 36′ 56″ longitude west. Has *one* fixed light, visible fifteen nautical miles. Height of light above sea-level eighty-three feet. Order of lens, *third* order lens apparatus. Tower built 1859, of iron, painted black.

Total number of vessels arrived during 1866, 11,084; seamen, 93,554; tonnage, 2,258,527. Total number of vessels cleared during 1866, 11,115; seamen, 94,464; tonnage, 2,361,529.

Number of vessels arrived during 1867, up to and including July 30, 1867, 5,556; seamen, 48,451; tonnage, 1,039,197. Number of vessels cleared during 1867, up to and including July 30, 1867, 5,819; seamen, 49,720; tonnage, 1,018,198.

Amount of duties collected on imported merchandise from January 1, 1866, to July 1, 1867, $676,876 92, specified as follows:

January 1, 1866, to June 30, 1866........................	$165, 808 45
July 1, 1866, to June 30, 1867............................	511, 068 47
	676, 876 92

Summary statement of receipts by lake at the port of Chicago, Illinois, during the year 1866.

Articles.	Amount.	Articles.	Amount.
Lumber.................feet.	676, 236, 000	Eggs..................barrels.	867
Shingles............thousand.	197, 169	Peas.................bushels.	12, 182
Lath..................do....	118, 405	Beans.................do...	651
Timber, square..........feet.	11, 615, 000	Wheat.................do...	236, 882
Heading..............mille.	11, 644	Corn..................do...	2, 210
Staves.................do...	10, 789	Oats..................do...	4, 041
Cedar posts..........number.	762, 105	Barley................do...	5, 546
Railroad ties..........do...	434, 452	Rye...................do...	412
Shingle and stave bolts..cords.	12, 845	Green hides..........number.	1, 750
Bark...................do...	21, 868	Dry hides.............do...	4, 428
Fire wood..............do...	140, 921	Leather...............rolls.	12, 507
Slabs..................do...	1, 095	Tallow...............barrels.	105
Pickets..............number.	2, 651, 000	Grease................do...	446
Telegraph poles........do...	12, 852	Seeds.................bags.	1, 374
Hoops..................do...	2, 287, 000	Hay..................bales.	438
Spars..................do...	38	Hams.................barrels.	295

Summary statement of receipts by lake, &c.—Continued.

Articles.	Amount.	Articles.	Amount.
Woodenware.......... sets.	113,121	Pork.......... do...	2,222
Furniture.......... packages.	66,513	Beef.......... do...	224
Wagon stuff.......... sets.	38,913	Cattle.......... head.	181
Household goods... packages.	11,933	Sheep.......... do...	203
Pig iron.......... tons.	22,447	Hogs.......... do...	10
Railroad iron.......... do..	8,830	Horses.......... do...	357
Do.......... bars.	69,864	Wagons.......... number.	1,079
Iron.......... bundles.	55,399	Cement.......... barrels.	7,478
Iron ore.......... tons.	100	Lime.......... do...	28,247
Scrap iron.......... do..	74	Vinegar.......... do...	3,795
Do.......... barrels	12	Plaster.......... do...	23,129
Tin.......... boxes.	23,553	Wool.......... bales.	325
Zinc.......... casks.	1,881	Hair.... bales and barrels.	3,228
Lead.......... pigs.	6,111	Hemp.......... bales.	62
Do.......... tons.	3	Oakum.......... do...	2,422
Copper.......... do..	160	Pitch.......... barrels.	2,774
Do.......... barrels.	354	Tar.......... do...	1,416
Do.......... sheets.	171	Oil.......... do...	10,206
Do.......... ingots.	587	Cordage.......... coils.	12,615
Coal.......... tons.	378,713	Herrings.......... boxes.	17,542
Hardware.......... packages.	196,693	Agricultural implements . No.	3,806
Nails.......... kegs.	30,642	Reapers, mowers, and threshers.......... number.	616
Stoves.......... number.	55,203		
Castings.......... packages.	99,041	Bags.......... bales.	1,849
Copper.......... masses.	9	Empty barrels...... number.	20,952
Sugar.......... hogsheads.	11,840	Ship knees.......... do...	862
Do.......... barrels.	100,046	Sleighs.......... do...	40
Molasses.......... do...	16,180	Iron safes.......... do...	196
Salt.......... do...	493,407	Machinery.......... packages.	8,549
Do.......... bags.	2,381	Do.......... tons.	831
Do.......... tons.	2,915	Marble.......... pieces.	16,979
Fish.......... barrels.	101,206	Do.......... tons.	885
Liquors.......... packages.	19,123	Granite.......... do...	150
Glass and glassware.... do...	46,801	Stone.......... cords.	246
Earthenware.......... crates.	11,139	Fire-works.......... boxes.	1,967
Drugs.......... packages.	43,321	Tree boxes.......... number.	749
Fruit.......... do...	66,458	Boots and shoes....... cases.	16,921
Groceries.......... do...	318,212	Boiler plates.......... number.	106
Paints.......... do...	28,871	Engines.......... do...	12
Dry goods.... boxes and bales.	21,937	Boilers.......... do...	18
Paper.......... bundles.	20,667	Mill-stones.......... do...	230
Butter.......... kegs or tubs.	5,285	Grindstones.......... do...	2,565
Potatoes.......... bushels.	49,400	Do.......... tons.	231
Flour.......... barrels.	47,752	Pianos.......... number.	110
Melodeons.......... number.	38	Marble dust.......... barrels.	438
Organs.......... do...	22	Burr blocks.......... number.	2,446
Clothing.......... boxes.	1,706	Do.......... tons	46
Fire-brick.......... number.	2,193,000	Malt.......... bags.	599
Do.......... tons.	10	Hops.......... bales.	537
Do.......... casks.	731	Clocks.......... cases.	3,758
Fire clay.......... barrels.	695	Powder.......... kegs.	4,019
Do.......... tons	50	Broom corn.......... bales.	1,800
Drain tile.......... boxes.	146	Powder.......... tons.	60
Retorts.......... do...	221	Buffalo robes.......... bales.	29
Scales.......... do...	5,095	Row boats.......... number.	8
Slate.......... packages.	58	Powder magazines..... tons.	6
Do.......... tons.	131		

Summary statement of shipments by lake from the port of Chicago, Illinois, during the year 1866.

Articles.	Amount.	Articles.	Amount.
Wheat ... bushels.	5,827,846	Iron ... bundles.	8,487
Corn ... do...	32,457,855	Do ... tons.	984
Barley ... do...	988,240	Lumber ... feet.	236,000
Oats ... do...	7,395,113	Coal ... tons.	724
Rye ... do...	1,029,629	Castings ... do...	37
Flour ... barrels.	481,491	Do ... packages.	1,176
Corn meal ... do...	10,143	Machinery ... do...	1,202
Feed ... bags.	51,937	Do ... tons.	103
Corn meal ... do...	10,143	Provisions ... barrels.	1,409
Seed ... do...	21,881	Doors, sash, &c ... dozen.	1,062
Broom corn ... bales	3,079	Earthenware ... crates.	1,054
Hay ... do..	9,523	Glassware ... packages.	1,689
Beef ... barrels.	12,923	Stoneware ... pieces.	4,093
Pork ... do...	26,661	Woodenware ... sets.	1,554
Lard ... do...	2,334	Leather ... rolls.	1 997
Tallow ... do...	1,817	Stoves ... number.	557
Grease ... do...	453	Boots and shoes ... cases.	558
Hams ... do...	2,306	Horses ... number.	490
Bacon ... do...	556	Buggies ... do...	22
Butter ... kegs.	5,587	Wagons ... do...	107
Green hides ... number.	63,839	Carriages ... do...	14
Dry hides ... do...	31,819	Cattle ... head.	1,404
High wines ... barrels.	2,410	Hog ... do..	127
Oil cake ... do...	22,120	Sheep ... do..	256
Wool ... bales.	1,583	Tobacco ... packages.	1,190
Lead ... pigs.	762	Pitch ... barrels.	108
Do ... tons.	890	Oakum ... bales.	164
Dry goods ... boxes and bales.	13,508	Ship-stores ... packages.	346
Hardware ... packages.	30,284	Stone ... cords.	1,435
Groceries ... do...	108,941	Paper ... bundles.	1,365
Household goods ... do...	8,205	Felting ... rolls.	1,199
Paints ... do...	2,683	Belting ... do..	28
Eggs ... barrels.	2,317	Potatoes ... bushels.	3,846
Oils ... do...	2,901	Cabbage ... heads.	11,500
Salt ... do...	5,914	Vegetables ... barrels.	6 41
Furniture ... pieces.	4,134	Pianos ... number.	16
Liquor ... packages.	4,246	Melodeons ... do...	16
Fruit ... barrels.	6,595	Organs ... do...	4
Lime ... do...	4,695	Sewing machines ... do...	11
Drugs ... packages.	3,580	Engines ... do...	25
Boilers ... number.	35	Hoops ... number.	424,000
Iron safes ... do...	7	Shingles ... thousand.	59
Grindstones ... do...	166	Stearine ... barrels.	75
Lenses ... boxes.	82	Hemp ... bales.	62
Reapers and mowers ... number.	193	Marble ... pieces.	66
Agricultural implements ... do...	309	Scrap-iron ... barrels.	151
Harness ... do...	87	Plaster ... do...	34
Scales ... boxes.	82	Slate-roofing ... tons.	19
Cement ... barrels.	565	Billiard table ... number.	1
Clocks ... boxes.	49	Life-boat ... do...	1
Hair ... bales.	783	Guns ... cases.	277
Waste ... do..	18	Mill-stones ... number.	5
Rags ... do..	215	Lightning-rods ... do...	120
Gunny bags ... do..	107	Fire-clay ... barrels.	89
Empty barrels ... number.	6,156	Matting ... bales.	47
Brick ... do...	138,700	Hops ... do..	52
Drain-tile ... do...	1,529	Marble dust ... barrels.	33
Rope ... coils.	291	Staves ... thousand.	76
Beeswax ... barrels.	17	Feathers ... bales.	9
Sheep pelts ... bales.	727	Lead ore ... pounds	2,000
Bone-dust ... barrels.	271	Buffalo robes ... bales.	9
Powder ... kegs.	54	Fish ... barrels.	938
Malt ... bags.	111		

Abstract of contract for improving Chicago harbor, Illinois.

Contractor.	Nature of contract.	Price.
John M. Corse..	12" timber, per linear foot	$0 28
Do	3" plank, per thousand feet (board measure)	31 75
Do	Brush, per cord	5 74
Do	Stone, per cord	8 74
Do	Delivering and driving white oak piles, each	11 98
Do	Framing and sinking cribs, per linear foot	11½
Do	Iron bolts, per pound	9½
Do	Iron spikes, per pound	14½
Do	Dredging inside of piers, per cubic yard	44
Do	Dredging outside of piers, per cubic yard	74

Abstract of materials received and used, labor performed, and amount paid to contractor up to September 1, 1867, at harbor of Chicago, Illinois.

Contractor, John M. Corse: timber, 33,282 feet; brush, 210 cords; iron, 133,147 pounds
Materials used and labor performed: timber, 28,910 feet; brush, 210 cords; iron, 17,770 pounds; framing, 11,628 feet.

Contractor.	For what paid.	Amount paid.
John M. Corse..	Iron	$12,649 96
Do	Brush	1,205 40
Do	Timber	8,074 80
		21,950 16

A 11.

ENGINEER DEPARTMENT,
Washington, July 10, 1867.

SIR: I respectfully transmit herewith a letter from Brevet Colonel J. B. Wheeler, corps of engineers, enclosing letters from W. B. Ogden and R. A. Conolly, asking the privilege for the Chicago Canal and Dock Company of having an opening at the extremity of the present north pier of Chicago harbor, for the purpose of improving the same.

The company referred to was incorporated by act of the legislature of Illinois, and has authority from the War Department, as well as from the State of Illinois, to construct a ship basin and canal immediately north of and adjacent to the north pier of Chicago harbor; and also the privilege of making an opening through the United States pier. This authorized opening would be at some point west of the light-house.

The United States has contracted for the extension of the north pier 600 feet, and as the contractor has not as yet sunk a crib, the company referred to wishes him to commence his work at a point distant 300 feet from the end of the present pier, instead of at the end, as required by the contract.

Colonel Wheeler expresses the opinion that the plan of improvement contemplated will not in any way injure the harbor, and recommends that the privilege asked for be granted. This department concurs in his recommendation, and accordingly submits the question for your decision.

Very respectfully, your obedient servant,

A. A. HUMPHREYS,
Chief of Engineers, Major General.

Hon. E. M. STANTON,
Secretary of War.

MILWAUKEE, WISCONSIN, *July* 2, 1867.

GENERAL: I have the honor to transmit herewith a letter of Mr. W. B. Ogden, of Chicago, and a letter of Mr. R. A. Conolly, with a tracing, forwarded me by them, concerning the projected improvement proposed by the Chicago Dock and Canal Company at the harbor of Chicago, Illinois.

This company was incorporated by an act of the legislature of the State of Illinois, and has permission and authority from the War Department, as well as from the State of Illinois, to construct a ship basin and canal immediately north of and adjacent to the north pier of Chicago harbor, and the privilege of making an opening through the United States pier. (See report of Colonel J. D. Graham for the year 1857.) This opening through the pier, under this permission, would be at some point west of the light-house.

They now ask the privilege of having the opening at the extremity of the present north pier, as shown in the accompanying tracing.

By having the opening at this point they are saved great expense in dredging out a basin, and the cost of cutting the opening in the pier.

The United States have contracted with John M. Corse to build six hundred (600) feet of pier-work, completing not less than three hundred and twenty (320) feet this season; and as the contractor has not yet sunk a crib, they wish to have him commence building this extension, not from the end of the present pier, as his contract calls for, but to commence at a point distant three hundred (300) feet. The question is, will it interfere with the proposed plan of improvement, or injure the harbor?

No, is the answer. It will do neither. The only interference will be an inconvenience to the contractor, and probably some additional expense to him.

I would therefore recommend that permission be granted the Chicago Dock and Canal Company to have an opening of three hundred (300) feet left at the extremity of the present pier, provided they guarantee to close in the basin by building the piers marked F E and E D during the present season. The piers to be built in a workmanlike manner, and upon a plan satisfactory to the engineer officer in charge; and that they also guarantee to settle all claims that the contractor may bring against the United States for increase of compensation for change of place, &c. The time of completion of contract, in this case, will have to be extended, and I would recommend (in case the privilege be granted) that he be allowed one year longer to build the six hundred (600) feet contracted for.

Any plan of improvement that will increase the dock facilities, or enlarge the harbor of Chicago, meets with my approval, and I earnestly recommend this one to your favorable consideration.

As the season is well advanced, I would ask for an early answer to this letter.

I am, general, very respectfully, your obedient servant,

J. B. WHEELER,
Major of Engineers and Brevet Colonel.

Major General A. A. HUMPHREYS,
Chief of Engineers U. S. Army, Washington, D. C.

CHICAGO, *June* 29, 1867.

DEAR SIR: With this you will receive the Chicago Dock and Canal Company's plans for enlarging and improving the Chicago harbor, in connection with the proposed extension of the north harbor pier by government, as prepared and submitted by R. A. Conolly, chief engineer of said Chicago Dock and Canal Company.

The present facilities and accommodations of the Chicago harbor are, as you are no doubt aware, very cramped and illiberal, and promise soon to be wholly inadequate to its rapidly increasing commerce.

The river is so narrow, and already so over occupied, that enlarged harbor facilities near its mouth would clearly afford the most efficient, ready, and important relief. This relief the plans and improvements of the Chicago Dock and Canal Company (a corporate body, and of which I am the largest proprietor) propose, in connection with the extension by the government of the north pier, to furnish now and hereafter, as shown on the plans of Mr. Conolly herewith submitted.

The changes effected by the plan submitted are, an extension of the north pier fifty per cent. further into the lake than as now proposed by government, furnishing thereby a more extended shelter for vessels and a protection of the harbor from drifting sands for a period of time at least fifty per cent. longer; second, an opening of three hundred feet in width east of and between the present end of the north pier and the beginning of the westerly end of the proposed six hundred feet extension of said north pier, through which opening vessels would have ready entrance and access to the basin and canals of the Chicago Dock and Canal Company, as shown on the map, which basin and canals will be extended and completed as commercial uses shall call for them, and will in the end serve to increase the facilities of the Chicago harbor to nearly twice its present capacity, and at the most convenient point possible for doing its business.

The Dock and Canal Company is ready to proceed at once and complete, as early this season as possible, the pier from the shore at F to the northeast corner at E, and from E to the point of junction with the proposed government extension of the north pier at D, the same to be done in a manner satisfactory to, and to be approved by, you. The company will also commence and proceed at once with their canal and interior piers or bulkhead, south and west of the pier above described.

Should the plans herewith submitted meet with the proper official approval, the details and particulars, and the proper adjustment and accommodation of the matter with Messrs. Ledlie and Corse, government contractors for the extension of the north pier, we would proceed at once with you and them to satisfactorily arrange.

With great respect, I remain, very truly yours,

W. B. OGDEN.

Colonel J. B. WHEELER,
Engineer Corps U. S. Army, Milwaukee.

CHICAGO, *July* 1, 1867.

SIR: I submit for your inspection a plan of the proposed harbor improvement at Chicago by the Chicago Dock and Canal Company, and with it a letter from the Hon. William B. Ogden, (one of the largest proprietors,) describing the proposed improvement.

The work the company contemplates this year is the construction of the pier from F to E and from E to D, as shown on the plan. The dotted blue lines show the proposed work by the company from year to year as business may demand its completion.

Very truly yours,

R. A. CONOLLY,
Chief Engineer Chicago Dock & Canal Company.

Major J. B. WHEELER,
United States Engineers and Colonel U. S. Army.

A 12.

MILWAUKEE, WISCONSIN, *September* 1, 1867.

COLONEL: I have the honor to submit the following report on Michigan City harbor:

This harbor was surveyed in April, 1867, by Captain A. Mackenzie, corps of engineers.

Congress had appropriated $75,000 for its improvement, to be applied when the city should show that $100,000 had already been expended in improving it.

The city having complied with its portion of the contract, the work was advertised and let on the 7th of August, 1867. The contemplated improvement consists in adding 288 feet of pier work to the eastern pier, the cribs composing the pier work to be each twenty-five feet wide, thirty-two feet long, and about twenty-five feet high and in adding 320 feet to the western pier, the cribs to be twenty feet wide, thirty-two feet long, and about seventeen feet high.

As the cost of a dredge and two mud-scows was included in the expenditure of the $100,000 by Michigan City, the government claims the right to use the dredge and scows without incurring any additional expense except the running expenses of the dredge. The government is now dredging out the channel and creek.

From the peculiar position of this harbor, at the head of Lake Michigan, exposed to all the severest winds, I hardly think it would be profitable to extend the piers further than the present contract calls for; and no matter how long they may be, they will not prevent the accumulation of sand at the mouth of the harbor, and the only remedy for this is periodical dredging. As the bed of the lake is a hard clay, the present dredging is quite a difficult work, but hereafter it will be quite easy, there being nothing but the accumulating sand to remove.

The importance of this harbor as a port of refuge can hardly be overestimated, as it is the only port south of Chicago where a vessel can take shelter. When finished, I also believe that it will be of great advantage to Indiana, affording the State an easy and cheap means of transporting her products and receiving those of other States. Now she has to depend on her railroads, always an expensive means of transportation.

Annexed there is the report of the collector, a tabular statement of material received and work done to 31st of August, and an abstract of the contracts for improving the harbor; also estimates for the cost of improving it.

Very respectfully, your obedient servant,

D. P. HEAP,
Captain of Engineers.

Major and Brevet Col. J. B. WHEELER,
Corps of Engineers.

The port of Michigan City is included in the collection district of Chicago. The nearest port of entry is Chicago. Michigan City was made a port of delivery by act of Congress, under date of February 23, 1865. Order of light *fifth;* fixed white light. No revenue collected. Imports on cargo, 158,000 feet lumber during 1866. No exports. Vessels sailing to Michigan City since July 1, 1866, 94; vessels sailing from Michigan City since July 1, 1866, 94.

Abstract of bids for improving the harbor at Michigan City, Indiana.

1. FRANCIS A. SLATER, Chicago.—12-inch square timber, at 14 cents per lineal foot; iron bolts, at 7½ cents per pound; stone, at $2 66½ per cubic yard; framing, at 13 cents per lineal foot.

2. J. D. Dolan, Milwaukee.—12-inch square timber, at 15 cents per lineal foot; 3-inch plank, at 16 cents per lineal foot; iron bolts, at 6 cents per pound; iron spikes, at 8 cents per pound; stone, at $2 62½ per cubic yard; brush, at 75 cents per cubic yard; framing, at 17 cents per lineal foot.

3. Galen Eastman, Grand Haven.—12-inch square timber, at 17.9 cents per lineal foot; 3-inch plank, at $15 75 per thousand feet; iron bolts, at 5.9 cents per pound; iron spikes, at 7.9 cents per pound; stone, at $2 90 per cord; brush, at 60 cents per cubic yard; framing, at 24 cents per lineal foot.

4. George Hannahs, South Haven.—12-inch square timber, at 16¾ cents per lineal foot; framing, at 14¾ cents per lineal foot.

5. M. G. Sherman, Michigan City.—12-inch square timber, at 19 cents per lineal foot, pine; 12-inch square timber, at 17 cents per lineal foot, other; 3-inch plank, at $16 per thousand feet; iron bolts, at 5 cents per pound; iron spikes, at 8½ cents per pound; stone, at $3 18 per cubic yard; brush, at $1 25 per cubic yard; framing, at 17 cents per lineal foot.

6. Chapin & Wells, Milwaukee.—Iron bolts, at 4⅞ cents per pound; iron spikes, at 6½ cents per pound.

7. Hasbrouck & Conro, Milwaukee.—12-inch square timber, at 20 cents per lineal foot; iron bolts, at 7 cents per pound; stone, at $16 per cord; brush, at $6 per cord; framing, at 15 cents per lineal foot.

8. James H. Mallory, Elgin, Kane county, Illinois.—12-inch square timber, at 21½ cents per lineal foot; 3-inch plank, at $24 per thousand feet; iron bolts, at 5¾ cents per pound; iron spikes, at 13 cents per pound; stone, at $15 90 per cord; brush, at $6 per cord; framing, at 13½ cents per lineal foot.

9. Silver & Bowes, Michigan City.—12-inch square timber, at 19 cents per lineal foot; iron bolts, at 5½ cents per pound; stone, at $15 75 per cord; framing, at 19½ cents per lineal foot.

10. Barker & Roberts, Michigan City.—12-inch square timber, at 18 cents per lineal foot; 3-inch plank, at $16 per thousand feet; iron bolts, at 4 9 cents per pound; iron spikes, at 8 cents per pound; stone, at $15 50 per cord; brush, at $3 per cord; framing, at 18 cents per lineal foot.

Abstract of contract for improving the harbor of Michigan City, Indiana.

Contractor.	Nature of contract.	Price.
J. D. Dolan	Stone, per cubic yard	$2 62½
Do	Brush or slab. per cubic yard	75
F. A. Slater	For twelve-inch square timber, per lineal foot	14
Do	For framing, including placing, sinking, and filling the cribs, per lineal foot	13
Chapin & Wells	For bolts, per pound	4⅞
Do	For spike, per pound	6½

Abstract of materials received and used, labor performed, and amount paid to contractors up to September 1, 1867, *at harbor of Michigan City, Indiana.*

Labor performed, 6,065 cubic yards of dredging. The contractors have not been paid for any work done or material delivered up to 1st September, 1867.

At the present contract prices the cost of extending these piers as proposed will be as follows:

CRIBS 32′ × 25′ × 25′.

4,159 running feet of timber, at 14 cents	$582 26
288 feet of plank, at $14 per M	4 03

4,762 pounds of iron bolts, at 4⅞ cents	$232	15
6 pounds of iron spikes, at 6½ cents		39
112 cords of stone, at $12 44	1,393	28
13 cords of brush, at $3 55	46	15
4,159 running feet of framing, at 13 cents	540	67
Cost of one crib	2,798	93
288 feet of pier-work will take nine cribs, which at this price will cost	25,190	37
Add ten per cent. for contingencies	2,519	03
Making the sum total for extending the eastern pier	27,709	40

The cost of extending the western pier will be as follows:

CRIB 32′ × 20′ × 17′.

3,378 running feet of timber, at 14 cents	$472	92
288 feet of 3-inch plank, at $14 per M	4	03
3,880 pounds of iron bolts, at 4⅞ cents	189	15
6 pounds of iron spikes, at 6½ cents		39
90 cords of stone, at $12 44	1,119	60
10 cords of brush, at $3 55	35	50
3,318 running feet of framing, at 13 cents	439	14
Cost of one crib	2,260	73
320 feet of pier-work will take ten cribs, which at this price will cost	22,607	30
Add ten per cent. for contingencies	2,260	70
	24,868	00
Add cost of eastern pier	27,709	40
Making the total cost for both piers	52,577	40

Subtracting this sum from $75,000, the amount of the appropriation, leaves $22,422 60, a sum sufficiently large to pay for all the dredging required, estimating the cost of dredging at 20 cents per cubic yard. This sum will pay for 112,113 cubic yards, and I do not think it likely that a greater amount of earth will have to be removed.

The bottom of the channel is almost entirely composed of remarkably hard and tenacious clay. So difficult is it to be removed that in places it is necessary for the dredge to break it up into lumps before attempting to take it out. This dredge is extra large, and there is probably not a stronger one on the lake. I do not think that any reliable contractor could be found who would be willing to undertake the dredging for much less than 50 cents per cubic yard. There will be therefore a large saving on account of having the use of this dredge for nothing.

MILWAUKEE, WISCONSIN, *September* 12, 1867.

COLONEL: In addition to my report on Michigan City, I have the honor to respectfully submit the following estimate of the cost of dredging at that place. I only received the data to-day on which to base the estimate.

By roll of men engaged in working the dredge and hauling and dumping mud scows, for one month	$859 63
Repairs of dredge for same period	219 76
	1,079 39
Amount of earth excavated	9,235 cubic yards.
Cost per cubic yard	$11 68

The pay-roll includes the pay of the foreman at six dollars per day.

The earth was dumped by laborers, who hauled the scows out into the lake by hand—a tedious, slow, and laborious process. During the greater portion of this month there will be a tug used for this purpose, and six of the laborers discharged. In this way I think there will be a much larger amount of earth excavated, and that it will cost no more per cubic yard.

Very respectfully, your obedient servant,

D. P. HEAP,
Captain of Engineers.

Major and Brevet Col. J. B. WHEELER,
Corps of Engineers.

A 13.

MILWAUKEE, WISCONSIN, *June* 5, 1867.

GENERAL: In compliance with your instructions of March 9, 1867, I ordered Captain A. Mackenzie, United States engineers, on the 2d of April, 1867, to proceed to Michigan City, Indiana, and make a full and accurate survey of that harbor, a careful examination of the piers and other works, and to report as to the safety and convenience of the harbor for the purposes of commerce. A copy of his report, marked A, and a tracing of the map of the harbor, is herewith appended.

As the law requires that the Michigan City Harbor Company shall show an expenditure of the sum of one hundred thousand (100,000) dollars in the construction of a safe and convenient harbor at that place before the appropriation was available, the engineer and secretary of the company, Mr. Daniel Kennedy, was requested to inform me when the expenditures would reach that amount. I received a letter from him, dated May 21, 1867, stating that, including the pay-rolls for the month of May, the amount of expenditures of the company in improving the harbor would be slightly in excess of $100,000.

I proceeded with Captain Mackenzie to Michigan City on the 31st of May, and on that day and the 1st of June made an examination of the harbor, the piers, dredges, scows, and vouchers of disbursement of the company. I find that they have expended, in the construction of the harbor at that place, a sum slightly in excess of $100,000. An abstract of these expenditures is herewith appended, marked B.

The piers are composed of cribs filled with stone, and conform in the main features to the plans adopted by the engineer department. They were built by contract and appear to have been executed in a workmanlike manner. For dimensions, details, &c., see report of Captain Mackenzie.

The company contracted for dredging, and this was sub-let to Fox & Howard, of Chicago, Illinois. Disputes between the contractors and the directors of the company resulted in an abandonment of the dredging by the contractors. Hence there was but little dredging done, and that of no use as far as improvement of the harbor was concerned.

The directors decided to build a dredge and do the work themselves. They now have a fine dredge with dump scows, the whole costing about $17,000. The dredge was at work when I was there, and proved itself an excellent machine capable of doing the required work.

The question is, have they constructed a safe and convenient harbor at Michigan City? My answer is, they have not, but have done much towards it. By a liberal construction of the law, I think they have complied with its requirements, and are entitled to the benefit of the present appropriation.

I would recommend that this amount appropriated be applied to extending the northeastern pier a distance of two hundred and eighty-eight (288) feet on a line with its present direction, an extension of the western pier three hundred and twenty (320) feet on a line with the direction of the end crib, and dredge the channel between the piers and in the creek to a depth of twelve feet. These extensions to be composed of cribs built in accordance with plans approved by the engineer department. This will carry the piers into a depth greater than twelve feet of water, will widen the entrance to one hundred and fifty feet, and will render it a safe and convenient harbor for those vessels sailing to Michigan City, or compelled to seek refuge there during severe gales from the north and northeast, which are the worst that prevail in that section.

I would recommend, in preference to letting the work of dredging by contract, to use the dredge now on hand, paying the running expenses. And I take advantage of this opportunity to call the attention of the department to the fact that this company, consulting its best interests, have abandoned the system of contracting for dredging and do the work themselves, while we have abandoned the system of doing the work, and gone into a worse one of doing the work by contract. A latitude of judgment should be given in these matters to the officer in charge, and power given him to stop any contract, and do the work himself if the contractors fail, or do not progress satisfactorily in their work.

I am, general, very respectfully, your obedient servant,

J. B. WHEELER,
Major of Engineers and Brevet Colonel.

Major General A. A. HUMPHREYS,
Corps of Engineers, Chief of Engineers U. S. Army,
Washington, D. C.

[A.]

MILWAUKEE, WISCONSIN, *May*, 1867.

COLONEL: In accordance with your instructions of April 2, 1367, I proceeded to Michigan City, Indiana, and made a complete survey of the proposed harbor. I have the honor to submit the following report, attached to which will be found a map of harbor, abstracts of work done by the Michigan City Harbor Company, money and material expended by them, and the material still on hand. These abstracts were prepared by the secretary of the company in my presence, and taken from the vouchers properly signed. I have added a table showing the shipments from Michigan City for the year 1847; and one showing the rise and fall of Lake Michigan during the time I was making the survey.

The harbor at Michigan City is in so poor a condition that it can hardly be called a harbor. The government commenced work here in 1836, and have expended in all about $135,000. The different appropriations were small and made at long intervals; large amounts were paid for salaries, dredges, scows, &c. The material was collected on the beach, and rotted before money could be had to put it in the piers. The work consequently went to decay and was abandoned. A few cribs were put in place; these have been cut down and made the foundations for new piers. The old plan of improvement contemplated a break-water in front of the entrance, and one crib was put in place, but it was torn from its bottom timbers by the waves, and washed ashore in a few hours.

A few years since, the people of Michigan City and vicinity organized the Michigan City Harbor Company, with a capital stock of $300,000. They raised by subscription about $206,000. Authority was granted by Congress to use the old government piers as foundations, and contracts were let to repair the old work, extend the piers into 12 feet of water and dredge about 50,000 cubic yards. The contractors failed to complete their work, only sinking 16 cribs and removing 10,000 cubic yards. Very little of the material dredged was carried out, but dumped into the channel between the piers; during the winter it washed back into its old bed.

The east pier is 1,135 feet in length, and the west pier 994 feet; 250 feet will carry the east pier over the bar. The cribs are substantially built, and their plan is similar to the one you have adopted. The channel between the piers is 100 feet wide, and the depth of water will only allow the passage of small fishing boats.

Trail creek has an average depth of 3 feet, and a width of 60 or 70 feet; its bed is hard clay covered with sand, washed from the sand hills through which the creek passes. About three-quarters of a mile above the mouth the creek widens into a marshy swamp of more than fifty acres, which the company propose to use as a basin. It is to be dredged together with the creek, and the shores from the piers up to the railroad bridge docked. Above the Michigan Central railroad bridge is a still more extensive swamp. Nearly all the sand in the channel is washed from the hills below the bridge; very little comes down from above. Most of the wash will be stopped when the banks are docked, though some sand will still find its way into the channel and require occasional dredging. The harbor company have almost completed a dredge; it is built in the best possible manner, and will be in operation by the 1st of June, 1867. They propose to extend both piers this year.

A break-water at the entrance to Michigan City would be of great advantage to the commerce of the lake, as it would afford vessels a safe anchorage in hard northerly blows; but to be of service, it should be at least half a mile from shore, and more extensive than the one formerly proposed. It would require a very strong structure and cost an immense sum.

A good harbor is needed at Michigan City, not only on account of its being at the foot of the lake, where vessels can run when they cannot make side ports, but on account of the fine country back of it. For the year ending September, 1847, the shipments of grain, &c., were very large. A table of shipments, &c., is added. Most of the vessels were loaded at wharves running into the lake; others came up the creek and loaded at the warehouses shown on the map. The old wharves have disappeared. Keeping the harbor open will always be attended with more or less difficulty, but the people have gone to work with the determination of making a harbor, and I think they will succeed. They have already expended nearly $100,000, and expect by the middle of May, 1867, to fully reach that sum.

I am, very respectfully, your obedient servant,

A. MACKENZIE,
Captain United States Engineers.

Brevet Colonel J. B. WHEELER,
Major of Engineers United States Army,
Superintending Engineer of Harbor Improvements, Milwaukee, Wis.

Shipments of grain, &c., at Michigan City for the year ending September, 1847.

Wheat, corn, and other grains, bushels	617,134
Pork, beef, and other cask freight, barrels	4,798
Hides, number	1,295
Wool, sacks	175
Merchandise received, tons	2,946
Number of arrivals of vessels, including propellers	196
Number of times steamboats touched at this point with passengers and freight	144

Amount expended by the Michigan City Harbor Company in building piers, &c., to May, 1867.

Organization, collecting subscriptions, &c	$3,964	81
Salaries	2,798	50
Office expenses, rent, furniture, &c	735	64
Repairs, and construction of piers	62,417	10
Excavation, (dredging, &c., for placing cribs)	6,874	56
Materials on hand, timber, piles, plank, &c	5,374	55
Dredge, four scows, pile driver, ropes, chains, and tools	15,028	03
Pay-rolls for April, 1867	1,400	00
	98,593	19

Materials on hand.

Timber, cubic feet	13,332
Plank, M feet, board measure	55
Piles, lineal feet	6,965
Wood, cords, for dredge	230½

Materials used in construction and repair of piers.

Timber, cubic feet	81,118
Plank, M feet, board measure	12
Iron, pounds	56,241
Stone, cords	1,990

Amount of work done.

EAST PIER.

371	feet,	4	feet high,	20 feet wide.	
200	do.	5	do.	do.	
34	do.	7	do.	do.	
40	do.	8	do.	do.	
30	do.	9	do.	do.	
30	do.	10	do.	do.	crib sunk.
50	do.	11½	do.	do.	do.
50	do.	13	do.	do.	do.
30	do.	16	do.	do.	do.
60	do.	20	do.	do.	do.
60	do.	23	do.	do.	do.
60	do.	24	do.	do.	do.
60	do.	25	do.	do.	do.
60	do.	26	do.	do.	do.
1,135	do.				

WEST PIER.

385 feet,	4	feet high,	20 feet wide.	
290 do.	5	do.	do.	
40 do.	6	do.	do.	crib sunk.
60 do.	8	do.	do.	do.
50 do.	10½	do.	do.	do.
50 do.	13	do.	do.	do.
60 do.	16	do.	do.	do.
60 do.	22	do.	do.	do.
995 feet.				

Record of rise and fall of Lake Michigan from April 12 *to April* 20, 1867.

Date.	7 a. m.	12 m.	6 p. m.	Remarks.
	' ''	''	''	
Friday, April 12	0 1.5	1.25	0	Southwest wind, light.
Saturday, April 13	4.75	3.75	4.75	Southwest wind, light.
Sunday, April 14	3.75	3.5	3.25	Southwest wind, light; rain.
Monday, April 15	4.25	5	4.5	North wind, heavy; hard rain.
Tuesday, April 16	8	8.5	9	North wind, very heavy; foggy; rain.
Wednesday, April 17	4.5	4.75	2.75	Southwest wind, light.
Thursday, April 18	5	4.75	4	Southwest wind, light.
Friday, April 19	6.5	....	....	
Saturday, April 20	....	3.25	....	

NOTE.—The numbers in the above table are relative. There has been no record kept for several years, and no marks could be found to which the present could be referred. The inhabitants think the lake is about two feet lower than at the time Mr. Bowes made his survey in 1852.

Statement of expenditures of Michigan City Harbor Company to date, June 5, 1867.

In organizing and collecting stock subscriptions	$3,964 81
Salaries	3,111 20
Office expenses, rent, furniture, fuel, stationery, &c	735 64
Repairs and construction of piers	62,478 25
Excavation	7,107 93
Materials on hand, timber, plank, iron, piles and wood	5,374 55
Dredge and four scows, pile driver, and other tools	17,753 65
	100,526 03

The May pay-rolls, which are included in the above statement, amount to	$1,482 24

A 14.

MILWAUKEE, WISCONSIN, *June* 24, 1867.

GENERAL: I have the honor to transmit herewith the statement of expenditures made by the Michigan City Harbor Company in improving the harbor at Michigan City, duly authenticated by the engineer and secretary of the company, Mr. Kennedy, as requested by you in your letter of June 14, 1867.

I think in reference to the expenditure of $17,753 65 for a dredge, scows, &c., that this amount can fairly be allowed them.

It is true that the sum is large, and that the amount of dredging required to be done by the United States would hardly seem to justify so large an expenditure of money.

But a close examination of the amount and kind of material to be dredged changes in a slight degree this opinion.

It is estimated, by Captain A. Mackenzie, United States engineers, to require the removal of 45.000 cubic yards of material in order to deepen the present channel between the piers, from the extremity of the present eastern pier to the extremity of the inside government work, to a uniform depth of twelve feet. A portion, about one-half of the material to be removed will be a very hard and tough clay.

Contractors are paid by the cubic yard, measured in scows, and their prices at this place would average for the ordinary or soft material thirty-five cents per cubic yard, and for the hard clay about seventy (70) cents per cubic yard.

The 45,000 cubic yards, obtained by calculation from the cross sections, would measure from 60,000 to 75,000 cubic yards in scows.

Taking the smaller of these amounts, and estimating the cost of one-half at thirty-five cents and the other at seventy cents per cubic yard, we would find the cost to be not less than $31,500. The cost of the dredging required to be done by the United States will not be less than this if done by contract.

And I firmly believe that they have shown true economy in building a dredge, and they can fairly claim the amount expended as coming under the head of money expended in the construction of a safe and convenient harbor at that place.

The item of "organizing and obtaining stock," amounting to $3,964 81, is hardly a legitimate expenditure under the law; but as this amount is less than five (5) per centum expended, I think it might fairly come under the head of contingent expenses and be allowed.

I am, general, very respectfully, your obedient servant,

J. B. WHEELER,
Major of Engineers and Brevet Colonel.

Major General A. A. HUMPHREYS,
Corps of Engineers, Chief of Engineers U. S. A.,
Washington, D. C.

Statement of expenditures of the Michigan City Harbor Company to June 5, 1867.

In organizing and collecting stock subscription	$3, 964 81
In salaries	3, 111 20
In office expenses, (rent, furniture, fuel, stationery, &c.)	735 64
In repairs and construction of piers	62, 478 25
In excavation, (dredging channel and for placing cribs)	7, 107 93
In material on hand, (timber, plank, piles, wood, and iron)	5, 374 55
In building dredge, four scows, pile-driver, and other tools	17, 753 65
	100, 526 03

DAN. KENNEDY,
Engineer and Secretary Michigan City Harbor Company.

STATE OF INDIANA, *Laporte County, ss:*

Be it known that on the nineteenth day of June, in the year 1867, before me, William Schoenemann, a notary public in and for said county, personally appeared Dan. Kennedy, and made oath in due form of law that the annexed statement of the expenditures of the Michigan City Harbor Company is a true and faithful statement and exhibit of the amount of money expended on the harbor at Michigan City, under his direction as engineer of said harbor company.

Sworn and subscribed to before me the day and year aforesaid.

WM. SCHOENEMANN,
Notary Public.

I hereby certify that Dan. Kennedy, whose name is subscribed to the foregoing statement, is now, and has been since our organization as the Michigan City Harbor Company, engineer and secretary of the same; and that the annexed statement is a true and faithful exhibit of the amount of money expended by said company in the improvement of the harbor at Michigan City since its organization, October 12, 1864, under his superintendence.

D. J. BALDWIN,
Director and Treasurer Michigan City Harbor Company.

A 15.

MILWAUKEE, WISCONSIN, *September* 1, 1867.

COLONEL: I have the honor to submit the following report on the harbor at New Buffalo, Michigan:

This harbor, as will be seen by the annexed table of exports and imports, is of no value commercially. As a harbor of refuge, however, it is of considerable importance, as it is to the leeward of the most prevalent and violent storms of Lake Michigan.

The present improvement consists in cutting through the embankment between Lake Pottawatomie and Lake Michigan, and in sheath-piling the sides of the cut. This cut is to be two hundred feet wide, and dredged to a depth of twelve feet. Such pier work is to be done as the appropriation will warrant.

I would recommend that next year two piers be built on the extension of the cut, and their end carried into twelve feet of water. They will each have to be six hundred feet long. The channel will also have to be dredged to a depth of twelve feet, necessitating the removal of 28,000 cubic yards of material.

The cost of this improvement will be as follows:

One crib, 32′ × 20′ × 17′.

2,368 running feet of timber, at 24 cents	$568 32
3,554 pounds of iron bolts, at 10 cents	355 40
6 pounds of iron spikes, at 10 cents	60
226 cubic yards of stone, at $2 70	718 20
32 cubic yards of brush, at $3	96 00
2,368 running feet of fencing, at 17 cents	402 50
288 feet of 3″ plank, at $30 per thousand	8 64
	2,149 72
Add ten per cent. for contingencies	214 97
	2,364 69
Forty cribs will then cost	$94,587 60
28,000 cubic yards of dredging, at 50 cents	14,000 00
	108,587 60

Collection district of New Buffalo, Chicago. Nearest port of entry, Chicago. No revenue collected. No exports; no imports. Nearest light-house, at Michigan City. No vessels sailing to or from the harbor.

Annexed is an abstract of contracts; also an abstract of work performed and paid for up to date.

Very respectfully,

D. P. HEAP, *Captain of Engineers.*

Major and Brevet Col. J. B. WHEELER,
Corps of Engineers.

Abstract of materials received and used, labor performed, and amount paid to contractors up to September 1, 1867, *at harbor of New Buffalo, Michigan.*

Materials received, none.
Materials used, none.
Labor performed, 11,250 cubic yards dredging.
Paid to Carkin & Kimball for dredging, $2,135 20.

Abstract of contracts for improving New Buffalo harbor, Michigan.

Contractors.	Nature of contract.	Price.
Carkin & Kimball	12-inch timber, per thousand feet, board measure	$15 00
Do	3-inch plank, per thousand feet, board measure	16 00
Do	Piles, per lineal foot	8
Do	Stone, per cord of 128 cubic feet	15 75
Do	Brush, per cord of 128 cubic feet	2 90
Do	Framing, per lineal foot of timber	8¼
Do	Driving piles, per lineal foot of timber	6¼
Do	Dredging and excavating, per cubic yard, (in ordinary material)	34
Do	Dredging and excavating in hard material	70
R. Nelson Gere	Iron bolts, per pound	4.9
Do	Iron spikes, per pound	4.9

A 16.

MILWAUKEE, WISCONSIN, *September* 1, 1867.

COLONEL: I have the honor to submit the following report on the harbor of St. Joseph, Michigan.

This harbor, when developed, will make one of the finest harbors of the lake.

St. Joseph's river, before entering Lake Michigan, spreads itself into a basin 800 feet wide, with an opening into Lake Michigan 225 feet wide. The town is situated on the south of this basin, and a good depth of water is obtained for a distance of 2,000 feet from the outlet. The channel averages 150 feet in width.

The north pier is about 1,100 feet long. This spring a contract was made to extend the south pier 200 feet. 700 feet more will be necessary to make this pier equal in length to the north pier.

The current of the river is quite rapid, and as soon as it passes the end of the south pier it turns to the south and runs along the shore. By extending the south pier, it will confine the current, and probably clear out a portion of the interior basin. I would therefore recommend that the south pier be made equal in length to the north.

The extension of the 200 feet previously spoken of costs at the rate of $70 per foot of pier. It consists of a pile pier, with a crib-work superstructure. The additional 700 feet will cost at about the same rate, making a total of $49,000. To build this extension of cribs will cost $110 per foot of pier, making a total cost of $77,000.

I would recommend that the extension be built of piles, on the score of economy. Though not as lasting as crib-work, still they will make a very good, serviceable pier, and will last for a long time.

The repairs on the old pier were let at the same time with the south pier extension. No additional appropriation should be necessary next year.

The following is an extract from a letter written on August 3, 1867, by Mr. S. C. B. Carpenter, the government agent at St. Joseph's:

* * * * * * * *

"The following information I have gathered from captains and others since I have been here:

"That the harbor is an easy one to make in a blow from the northerd, but lacks sufficient depth of water on the bar for large vessels.

"It is the opinion of all captains sailing here that I have talked with that if the south pier were extended equal to the north pier, the current of the river would be sufficient to cut the bar, give a straight channel, and at all times sixteen feet water.

"There is a large fleet of vessels trading at the different piers between here and Michigan City and Saugatuck that make this a place of refuge during storms.

"There are now four propellers making tri-weekly trips (two each night) between here and Chicago; another now being built (the Hippocampus) will run between here and Milwaukee.

"Mr. Aldrich, who took some pains last winter to obtain the amount of business done here, states that for the trade of this town about $600,000 worth of merchandise were brought to St. Joseph's in 1866. Warehouse-men state that about one-half that much is received for merchants back in the country.

"Shipments from the port for 1866 were, in part, 14,000,000 feet of lumber, 3,000 cords of wood, and fish to the amount of $50,000.

"The lowest estimate I have heard for the crop of black and whortleberries not yet gathered is 1,500 bushels, and 700,000 baskets of peaches; 50,000 baskets of pears; 30,000 barrels of apples, and 100,000 boxes of grapes.

"Exports for the months of June and July, 1867, from the deputy collector of the port of St. Joseph's:

Lumber, 2,634,000 feet.
Wood, 1,446 cords.
Railroad ties, 37,590.
Potatoes, 3,128 bushels.
Berries, 11,700 bushels.
Fish, 655 boxes of 200 pounds each.
Fish, 411 half barrels.
Flour, 127 barrels.
Leather, 128 rolls.
Rags, 92 bales.
Brick, 15,000.
Tallow, 20 barrels.

"Whole number of clearances within this period, 178; aggregate tonnage, 29,577 tons; revenue obtained from clearances is about $800 per year."

Annexed is a tabular statement of material required, and work done up to date, also an abstract of the contracts.

Very respectfully, your obedient servant,

D. P. HEAP,
Captain of Engineers.

Major and Brevet Col. J. B. WHEELER,
Corps of Engineers.

NOTE.—The light-house is at the mouth of the river, south side; the light is fixed, varied by flashes; intervals of flash, one minute and thirty seconds; distance visible, fifteen nautical miles; light of fourth order. The light is on the keeper's wooden dwelling.
D. P. H.

Abstract of contracts for improving the harbor at St. Joseph's, Michigan.

Contractors.	Nature of contract.	Price.
Hasbrouck & Conro.	For oak piles, each	$16 00
Do	For pine timber, per cubic foot	35
Do	For brush, per cord	3 00
Do	For stone, per cord	15 00
Do	For iron bolts, per pound	10
Do	For iron bolts with nut and screw, per pound	18
Do		

Abstract of materials received and used, labor performed, and amount paid to contractors up to September 1, 1867, *at harbor of St. Joseph, Michigan.*

Materials received of Hasbrouck & Conro, 20,913 feet timber, 171 piles, 551 cords stone, 30 cords brush, 26,378 pounds iron.

Materials used, 16,101 feet timber, 145 piles, 250 cords stone.

Labor performed, 16,101 feet framing.

Paid to Hasbrouck & Conro for timber, piles, stone, and iron, $20,708 79.

A 17.

MILWAUKEE, WISCONSIN, *September* 1, 1867.

COLONEL: I have the honor to submit the following report on the harbor of South Haven, Michigan:

This harbor is situated about sixty miles south of Grand Haven, it is important as a harbor of refuge and as an outlet to the lumber district of the counties of Allegan and Van Buren.

The proposed plan is to extend two piers 120 feet apart until they reach a depth of twelve feet, and to widen the river between the old piers; the only modification that I would suggest is to make the distance between the piers 200 feet.

I would respectfully refer to Assistant U. T. Casgrain's report of last December for estimates and a more detailed account of the place.

I wrote last July to obtain information concerning the exports and imports of the place, but as yet have received no reply.

Annexed is a tabular statement of work done and material received, also abstract of contracts.

Very respectfully,

D. P. HEAP, *Captain of Engineers.*

Major and Brevet Col. J. B. WHEELER,
Corps of Engineers.

Abstract of contracts for improving the harbor of South Haven.

Contractors.	Nature of contract.	Price.
Galen Eastman	12-inch timber, per M, board measure	$13 25
Do	3-inch plank, per M, board measure	15 00
Do	Piles, per lineal foot	8
Do	Stone, per cord of 128 cubic feet	14 37½
Do	Brush, per cord of 128 cubic feet	2 00
R. Nelson Gere	Iron bolts, per pound	4.9
Do	Iron spikes, per pound	4.9
Geo. Hannahs	Framing, per lineal foot of timber	14½

Abstract of materials received and used, labor performed, and amount paid to contractors up to September 1, 1867, *at harbor of South Haven, Michigan.*

Contractors.	Materials received.			
	Pine timber.	Other timber.	Stone.	Iron.
	Feet.	*Feet.*	*Cords.*	*Pounds.*
Galen Eastman	2,974	20,166	507	....
R. Nelson Gere	....	....	....	29,074

Materials used, 15,908 feet timber, 387 cords stone and 26,655 pounds iron.
Labor performed, 15,908 feet framing, and nine cribs placed.

Contractors.	For what paid.	Am't p'd.
Galen Eastman	Stone and timber	$9,323 88
Geo. Hannahs	Framing	2,127 44

A. 18.

BLACK LAKE, MICHIGAN.

This harbor was surveyed in October, 1866. A full report, showing the condition of the harbor and proposing plans for its improvement, was made at that time, and will be found in your last annual report. The plans there proposed were to improve the present outlet, rather than open a new channel. To do this the north pier was to be extended 250 feet, and the south pier 275 feet. At the entrance into Black lake the channel was to be close piled, 1,125 feet on the north side and 425 feet on the south side. The whole channel was to be dredged to a depth of twelve feet. These plans were approved and contracts let for all the work except the close piling. It was thought the appropriation would not be sufficient for the latter work.

The dredging was commenced August 6, and to the present time about 15,000 cubic yards have been removed. When the weather is pleasant the dredge works outside, preparing a foundation for sink pieces, and when rough it works inside between piers. It was so late when the dredging was commenced, that the framers have not had time to complete any work. Before the close of navigation they will place twelve cribs, six on each pier, and dredge the channel to twelve feet. Some of the cribs in place at the time of survey rested on sink pieces, and others on the sand. While those on the sand had settled unevenly and tipped, the cribs resting on the sink pieces were level and firm; it was therefore determined to use sink pieces as foundations for the new cribs. The sink pieces are made of brush done up in bundles, and formed into a float thirty feet wide and long enough to extend under two or more cribs, breaking joints with them. The bottom is dredged level and the sink pieces loaded evenly with stone until they sink.

The cost of entire work, including close piling, at present contract prices will be about $98,000. The appropriations of 1866 and 1867 amount to $106.615 31, and will be sufficient to complete the whole work in a permanent manner.

Black lake is in the district of Michigan, twenty-two miles south of Grand Haven, the nearest port of entry. The nearest light-house is at the mouth of the Kalamazoo river, eight miles distant; it is a fixed light of the sixth order.

Holland, at the head of the lake, six miles from the mouth, is the nearest settlement.

There are fifty-seven small vessels sailing to and from this harbor. The number of arrivals and departures during the past year has been about seven hundred, and the amount of revenue collected $1,000.

The exports have been as follows:

	Value.
Sawed timber, feet board measure, 1,066,808	$53, 340 00
Fire-wood, cords, 10,489	41, 956 00
Staves, number, 2,733,462	54, 669 24
Railroad ties, number, 29,985	8, 995 50
Hemlock bark, cords, 2,420	12, 100 00
Shingles, thousand, 379	1, 516 00
Sawed heading, pieces, 1,088,262	6, 529 57
Staves and shingles bolts, cords, 87	870 00
Leather	112, 000 00
Miscellaneous articles—flour, butter, &c	65, 214 95
	357, 191 26

The imports, consisting of merchandise, machinery, hides, household furniture, castings, manufactures, emigrants' effects, &c., will amount in value to not less than $450,000.

The benefits to commerce and navigation from the completion of this harbor are many. As a harbor of refuge it can hardly be excelled; it is easy of access, and has a capacity for any number of vessels, and vessels of any size. It will open to commerce a large tract of country, settled principally by Hollanders, and will have a tendency to increase the emigration of a class of thrifty and industrious European laborers. It opens to cultivation a tract of land valuable for fruit culture; and it is estimated that within a few years the shipments of fruit alone will exceed present exports.

I am, very respectfully, your obedient servant,

A. MACKENZIE,
Captain United States Engineers.

Abstract of material received and used, labor performed, and amount paid to contractors up to September 1, 1867, at harbor of Black Lake, Michigan.

Contractors.	Materials received.				
	Timber.	Plank.	Stone.	Brush.	Iron.
	Feet.	*Feet.*	*Cords.*	*Cords.*	*Pounds.*
John Roost	44, 808	4, 608			
James H. Ledlie					56, 012
L. N. Kimball			354	80	

Materials used, 30 cords stone.
Labor performed, 13,447 yards dredging one sink piece in place.

Contractors.	For what paid.	Am't paid.	Remarks.
James H. Ledlie	Iron	$2,478 34	Amount with 10 per cent., $18,314 85.
John Roost	Timber and plank	8,169 12	
L. N. Kimball	Stone and brush	4,485 24	
J. E. Miller	Dredging	1,350 68	
Am't expended, less 10 per cent.		16,483 38	

Abstract of contracts for improving Black Lake harbor, Michigan.

Contractors.	Nature of contract.	Price.
John Roost	12-inch timber, per lineal foot	$0 20
Do	3-inch plank, per thousand, board measure	25 00
Do	Sink pieces placed, per square yard	3 70
L. N. Kimball	Stone, per cord of 128 cubic feet	13 40
Do	Brush, per cord of 128 cubic feet	3 00
J. H. Ledlie	Iron bolts, per pound	6.9
Do	Iron spikes, per pound	15
J. E. Miller	Framing, per lineal foot of timber	9
Do	Filling with stone, per cord	80
Do	Dredging in ordinary material, per cubic yard	34½
Do	Dredging in hard pan or stiff clay, per cubic yard	69

A 19.

GRAND HAVEN, MICHIGAN.

The last survey of this harbor was made in 1865 by Colonel Raynolds. A tracing, on which was marked the proposed improvements, was forwarded last year. These improvements were, to extend south pier 600 feet; to build a north pier, commencing at shore opposite inner end of south pier and running parallel to south pier, to twelve-feet curve. The width of the channel will be 200 feet, and the direction of the piers will be that of present south pier. The bend in river on south side was to be close-piled.

The present appropriation, $105,000, will be sufficient to complete south pier and repairs. For the construction of a north pier $200,000 will be required, $75,000 of which can be used during the next fiscal year.

The contractors for the pier work commenced operations in June, 1867. They have placed six cribs in extension of south pier, and do not propose putting in any more this year. The superstructure of this work will be put on before the close of navigation. The cribs have been very poorly placed—they are uneven and out of line. To complete the superstructure piles must be driven to complete the line where cribs are displaced. The piles are necessary to prevent forming a shoulder, upon which the waves and ice would have great effect, and probably remove the superstructure. The trouble in sinking the cribs has arisen from not levelling the bottom to receive them. The close-piling was commenced this month, and will be completed this year. It has been run straight across the bend, instead of following the fifteen-feet curve, as was first intended. The latter plan gave a curved line, which would turn the current more gradually and avoid all danger of the piles being undermined; but they are now free from all danger, being driven firmly in very deep water.

The 309 feet of south pier repaired last year has not been completed. The stone for new work was so piled on this portion, the fender piles could not be driven. It was concluded to omit driving the piles at present, as they were not considered necessary for the safety of the work. The piles at the end on which the superstructure was built were some distance apart, and no intermediate piles could be driven on account of stones, which had gone through and covered the bottom. The end of this work should be filled with slabs and stone, which will now be kept in by a crib, which abuts against old work.

Grand Haven is the port of entry for the district of Michigan, which embraces all harbors from Aux Bec Scies south to St. Joseph. It is an important point, being one terminus of the Detroit and Milwaukee railroad, and on an extensive line of communication between the east and west. It is also a lumber market of some importance. It has a light-house, with light of —— order, a pier light, range lights, and a fog bell. The harbor has been this season in very good condition, there being fifteen feet of water on the bar between the red and black buoys, which mark the channel. When the close piling now under way is completed, all the bends in shore, from which sand formerly washed, will be protected. With a north pier the current, which is very strong at times, will be confined, and must keep the channel open.

It is estimated that, on an average, thirty vessels are lost annually, in consequence of not being able to enter the harbor during storms. A good and safe harbor, easy of access, south of Big and Little Points au Sable, would lead vessels to make it, in heavy weather, from the north, instead of attempting to weather these points, and running great risks of being driven upon the shore.

The number of vessels entering and leaving this harbor during the past year is 4,000, and the amount of revenue collected is $5,000.

I am, very respectfully, your obedient servant,

A. MACKENZIE,
Captain United States Engineers.

Abstract of contract for improving Grand Haven harbor, Michigan.—Piering.

Contractor.	Nature of contract.	Price.
James H. Ledlie	12-inch timber, per lineal foot	$0 22
Do	3-inch plank, per thousand, board measure	25 00
Do	Piles, pine, per lineal foot	8
Do	Piles, oak, per lineal foot	17
Do	Stone, per cord of 128 cubic feet	16 94
Do	Brush, per cord of 128 cubic feet	2 20
Do	Iron bolts, per pound	9
Do	Iron spikes, per pound	14
Do	Framing, per lineal foot of timber	11
Do	Driving piles, per lineal foot	7½

Abstract of contracts for improving Grand Haven harbor, Michigan.—Close piling.

Contractor.	Nature of contract.	Price.
R. A. Conolly	12-inch timber, per lineal foot	$0 24
Do	Piles, pine, per lineal foot	10
Do	Stone, per cord of 128 cubic feet	18 75
Do	Brush, per cord of 128 cubic feet	1 75
Do	Iron bolts and spikes, per pound	9
Do	Driving piles, each	1 75
Do	Framing, per cubic foot	9

Abstract of materials received, labor performed, materials used, and amounts paid to contractors at harbor of Grand Haven, to September 1, 1867.

Contractors.	Materials received.				
	Pine timber.	Other timber.	Piles.	Iron.	Stone.
	Feet.	*Feet.*	*Feet.*	*Pounds.*	*Cords.*
James H. Ledlie	14,760	5,168	....	99,894	627
R. A. Conolly	7,788	....	58,638	30,800	....

Materials used, 15,533 feet timber, 826 piles.
Labor performed, 15,533 feet framing, 826 piles driven, 6 cribs.

Contractors to whom paid.	For what paid.	Amount.	Remarks.
J. H. Ledlie	Timber	$3,834 08	Amount with 10 per cent., $3,230 90.
Do	Stone	9,559 25	
Do	Iron	3,537 48	
Do	Framing	1,228 40	
R. A. Conolly	Timber	7,671 84	
Do	Piles	5,276 42	
Do	Iron	2,494 80	
Do	Framing	174 96	
Do	Driving piles	1,300 94	
Am't with 10 per cent. deducted	....	29,078 17	

A 20,

MUSKEGON, MICHIGAN.

The plans for improving this harbor, as determined upon last year, have never been changed. The plan is to extend both piers on a line parallel to the inner face of south pier, commencing at the present extremities of present piers, and extending them to seventeen feet of water. For this extension there is required 700 feet of pier work. Its estimated cost was $58,450.

Fifty-nine thousand dollars ($59,000) has been appropriated for the work, and will be sufficient to complete it. Contracts for extending the piers seventy feet (twenty-two feet) were made May 31, 1867. The delivery of stone was commenced immediately, and more than one thousand cords have been already received. A quantity of stone has been lost in the channel through the carelessness of vessels carrying stone.

The contractor for framing has obtained permission to build his cribs at Grand Haven and tow them to Muskegon. He has not yet placed any, but has several, and ready to put in when the weather will permit.

No reports of exports or imports have been received. The shipments of lumber will probably amount to 200,000,000 feet. The number of vessels arriving and departing last year was about 3,000, and the amount of revenue collected $4,000.

Muskegon is in the collection district of Michigan, and the nearest port of entry is Grand Haven, twelve miles south. It has a small light-house, with lights of sixth order.

I am, very respectfully, your obedient servant,

A. MACKENZIE,
Captain United States Engineers.

Abstract of materials received and used, labor performed, and amount paid to contractors up to September 1, 1867, *at harbor of Muskegon, Michigan.*

Contractors.	Materials received.	
	Pine timber.	Stone.
	Board meas	*Cords.*
Ledlie & Corse	....	1,185
Galen Eastman	174,744	....

Materials used, none; labor performed, none.

Contractors.	For what paid.	Amount paid.	Remarks.
Ledlie & Corse	Stone	$12,442 04	Amount with 10 per cent., $16,066 44.
Galen Eastman	Timber	2,017 77	
Amount expended, less 10 per ct.		14,459 81	

Abstract of contracts for improving harbor at Muskegon, Michigan.

Contractors.	Nature of contract.	Price.
Galen Eastman	12″ timber, per M, board measure	$12 83
Do	3″ plank, per M, board measure	14 00
Do	Piles, per lineal foot	08
Ledlie & Corse	Stone, per cord of 128 cubic feet	13 88
Do	Brush, per cord of 128 cubic feet	2 00
R. Nelson Gere	Iron bolts, per lb	4.9
Do	Iron spikes, per lb	4.9
Heber Squier	Framing, per lineal foot of timber	12

A 21.

WHITE RIVER, MICHIGAN.

From the results of the survey of this harbor in October, 1866, it was determined to make a new cut at the foot of White lake, and thus avoid the narrow, winding channel through which the lake now discharges itself into Lake Michigan.

It was estimated last year that the total cost of harbor would be $170,530 80.

The prices at which contracts were let are much below estimated prices, and the above amount will still be amply sufficient. During the next fiscal year $75,000 can be judiciously expended. The contractors, Messrs. Fox and Howard, of Chicago, commenced dredging in July, 1867, and have already removed over 20,000 cubic yards. They expect to finish the cut before the close of navigation.

The contractors for material have commenced the delivery, and all the timber and piles will probably be received this year.

The framing contractors are to close pile the cut, and build such pier-work as shall be necessary. They will be unable to commence this work until the cut is finished.

With balance of present appropriation, after dredging and close piling, ten or twelve cribs can be placed.

White river is in the district of Michigan, and the nearest port of entry is Grand Haven. A small light is kept up by individual enterprise on north pier. The nearest light-house is at Muskegon, twelve miles distant. The number of arrivals and departures for the last fiscal year have been about nine hundred.

There is only five feet of water in the channel, and the class of vessels running to and from the harbor, necessarily small.

The shipments for the past year have been as follows:

Lumber, feet, board measure	60,000,000
Shingle bolts, cords	1,000
Shingles	20,000,000
Square timber, feet	500,000

The imports consisted of dry goods, provisions, &c., and amount in value to $300,000; machinery of all kinds, $100,000.

White lake is a beautiful body of water, six miles long, three miles wide, and sufficiently deep for vessels of any size. The principal settlement is Whitehall, formerly Mears, at the head of the lake.

I am, very respectfully, your obedient servant,

A. MACKENZIE,
Captain United States Engineers.

Abstract of materials received and used, labor performed, and amount paid to contractors up to September 1, 1867, *at harbor of White Lake, Michigan.*

Materials received, none.
Materials used, none.
Labor performed: Dredging, 21,335 feet.
Amount paid for dredging to Fox & Howard, $3,669 19.

Abstract of contracts for improving White River harbor, Michigan.

Contractors.	Nature of contract.	Price.
Thomas S. White	12-inch timber, per lineal foot	$0 14.1
Do	3-inch plank, per M, board measure	14 50
Do	Piles, per lineal foot	7
Carkin & Kimball	Stone, per cord of 128 cubic feet	14 90
Do	Brush, per cord of 128 cubic feet	1 42
R. Nelson Gere	Iron bolts, per pound	4.9
Do	Iron spikes, per pound	4.9
Carkin & Kimball	Framing, per lineal foot of timber	7
Do	Driving piles, per lineal foot of timber	5¼
Fox & Howard	Dredging, per cubic yard	28

A 22.

PENTWATER, MICHIGAN.

The plans and estimates for this harbor were made last year from a map prepared by the lake survey. The plan adopted for its improvement was to throw aside entirely the old slab piers; they were so irregular, and ran in so many directions, that no use could be made of them. The width of the outlet was to be increased to one hundred and fifty feet, the sides of the cut close piled, and piers extended into Lake Michigan over the bar a distance of twelve hundred and eighty feet. The whole channel was then to be dredged to a depth of twelve feet. The direction of the proposed piers was to be north seventy degrees west, (magnetic.) This has been slightly modified. The south pier commences at end of present south pier. In extending this pier the first crib has been made to abut against the southern portion of old pier, leaving about thirty feet of old slab work to be removed.

The north pier will commence at some point of old pier and be parallel to south pier.

The channel should be two hundred feet in width, but it will not be practicable to give it a greater width than one hundred and fifty feet.

The estimated cost of work last year was $327,713 40. This amount will be sufficient to complete the work in a permanent manner.

For the next fiscal year $50,000 will be required

Pentwater is in the collection district of Michigan, and the nearest port of entry is Grand Haven, sixty miles distant.

The nearest light-house is at Muskegon, fifty miles south. There are from fifteen to twenty vessels arriving and departing weekly; the total number of arrivals and departures during the past year being about eight hundred.

The shipments for the past season have been: Lumber, about 20,000,000 feet, board measure; shingles, about 25,000,000, number; bolts, 100,000 cords.

The imports compare favorably with exports, and consist principally of merchandise.

Pentwater is in the bay formed by Big and Little Points Au Sable, and when the harbor is completed will be easy of access in all kinds of weather.

As a benefit to commerce the effect of the appropriation has already been felt. The amount of business has almost doubled during the past season.

I am, very respectfully, your obedient servant,

A. MACKENZIE,
Captain United States Engineers.

Abstract of materials received and used, labor performed, and amount paid to contractor up to September 1, 1867, *at the harbor of Pentwater, Michigan.*

Materials received: P. M. Danaher, timber, 41,666¾ feet, 7,000 plank; F. D. Van Wagener, stone, 395 cords.
Materials used, none.
Labor performed, none.

Contractors.	For what paid.	Amount paid.	Remarks.
P. M. Danaher	Timber	$4 575 60	Amount with 10 per cent., $9,884.
F. D. Van Wagener	Stone	4, 320 00	
Total		8, 895 60	

Abstract of contracts for improving Pentwater harbor, Michigan.

Contractors.	Nature of contract.	Price.
P. M. Danaher	12-inch timber, per lineal foot	$0 12
Do	3-inch plank, per M, board measure	12 00
Do	Piles, per lineal foot	8
F. D. Van Wagener	Stone, per cord of 128 cubic feet	16 00
Do	Brush, per cord of 128 cubic feet	6 00
R. Nelson Gere	Iron bolts, per pound	4.9
Do	Iron spikes, per pound	4.9
Hasbrouck & Conro	Framing, per lineal foot of timber	14
Do	Dredging, per cubic yard	36

A 23.

PÈRE. MARQUETTE.

This harbor was surveyed by Colonel Raynolds last year. The plan adopted for its improvement is to build a south pier, commencing at a point on shore twenty feet south of present slab pier, and extending to bar, a distance of about six hundred and forty feet; to extend the north pier to the bar, a distance of four hundred and fifty feet; to remove the old slab pier on south side of channel; to cut down slab pier on north side to surface of water and replace it by crib work; to close pile to south side and to dredge to a depth of twelve feet, if necessary.

The direction of the piers will be north three degrees west, and the channel two hundred feet wide. The estimate for the improvement of this harbor made last year was $270,682 16, and will be sufficient to complete the work in a permanent manner.

During the next fiscal year $75,000 can be used. The contractor for building the piers, Mr. P. M. Danaher, is required to put in place eight cribs this year. He commenced the work in June, and has placed fourteen cribs up to this date. He expects to finish the entire work this year. The cribs already in position have not settled evenly, but the line is good, and there will be no difficulty in building the superstructure. Some cribs have settled into the sand six feet.

In accordance with your instructions I applied to parties at Père Marquette for information concerning the imports, exports, &c. I have been unable to learn anything. The only export of any consequence is lumber. The number of arrivals and departures of vessels for the past year was about five hundred.

Père Marquette is in the collection district of Michigan. The nearest port of entry is Grand Haven, and the nearest light-house at Muskegon. A light-house is being erected at Big Point Au Sable, eight miles north. The light, I understand, is to be of the first order.

I am, very respectfully, your obedient servant,

A. MACKENZIE,
Captain United States Engineers.

Abstract of contracts for improving Père Marquette harbor, Michigan.

Contractors.	Nature of contract.	Price.
P. M. Danaher	12-inch timber, per lineal foot	$0 12¼
Do	3-inch plank, per M, board measure	18 00
Do	Piles, per lineal foot	8
Ledlie & Corse	Stone, per cord of 128 cubic feet	13 98
Do	Brush, per cord of 128 cubic feet	1 49
R. Nelson Gere	Iron bolts, per pound	4.9
Do	Iron spikes, per pound	4.9
Hasbrouck & Conro	Framing, per lineal foot of timber	14
Do	Dredging, per cubic yard	36

Abstract of materials received and used, labor performed, and amount paid to contractors up to September 1, 1867, *at harbor of Père Marquette, Michigan.*

Materials received: P. M. Danaher, timber, 41,666⅔ feet; plank, 7,000 feet, board measure; Ledlie & Corse, stone, 1,378 cords.

Material used, none.

Labor performed: Framing, 24,000 feet; cribs placed, 14.

Contractors.	For what paid.	Amount paid.	Remarks.
Ledlie & Corse	Stone	$17,338 00	Amount with 10 per cent., $27,958 79.
P. M. Danaher	Timber	4,800 89	
Hasbrouck & Conro	Framing	3,024 00	
Total		25,162 89	

A 24

MANISTEE, MICHIGAN.

This harbor was surveyed in September, 1866, by W. T. Casgrain, assistant engineer, and party. Plans based upon the result of this survey were discussed in last yearly report. The plan of improvement proposed was to extend south pier in present direction nine hundred and sixty feet; to commence north pier at a point on present north pier opposite outer end of south pier and run it in a direction parallel to south pier to the twelve foot curve, a distance of nine hundred and sixty feet; to cut off a point of slab work inside south pier and widen the channel; to cut down all slab work to water surface and build crib work on old foundation; and to dredge the channel to a depth of twelve feet.

Since the survey one hundred feet of the north pier has been washed away. This has caused a slight change in the plans, the north pier being thrown twenty feet further to the north, and commenced at end of old pier. The estimates last year called for $180,949 to complete the work; $60,000 has since been appropriated, leaving $120,949 still needed. Of this $60,000 can be used during the next fiscal year.

Contracts have been made with Mr. Starke, of Milwaukee, to build and sink twenty-four cribs (768 feet) in extension of north pier. He is to sink not less than eight cribs this season; he has already placed three cribs.

There is at present eight and a half feet of water on the bar in front of entrance, from nine and a half to ten feet between piers, and from seven and a half to eight feet in river above the piers. To deepen the channel between Lake Michigan and Manistee lake to a depth of twelve feet will require the removal of four and a half feet of dirt for the whole length of Manistee river, a distance of one mile; the average width is about three hundred feet. This work has not been included in estimates. It has not been considered a portion of the work ordered. If it is to be done it will absorb the entire appropriation.

Manistee is in the collection district of Michigan, and the nearest port of entry is Grand Haven. The nearest light-house in operation is at Point Betsie, thirty-five miles north. A light-house is being built at Big Point Au Sable, twenty miles south of Manistee.

There is at present not even a pier light at Manistee, but money has been appropriated, and a light will be put up at end of piers when they are completed.

The number of vessels arriving and departing the past year is as follows:

Sail vessels, 640; averaging thirty-five per week this season.

Steamers, 95; averaging five per week this season.

The exports for past year are:

Material.	Quantity.	Value.
Lumber and timber (pine)	64,000,000 feet.	$800,000
Spars	1,000	25,000
Railroad ties	5,000	1,000
Cords of wood	3,000	7,500
Barrels of fish		15,000
		848,500

The imports are:

General merchandise	$700,000
Live stock	50,000
Machinery	60,000
Fruit trees	4,000
	814,000

Manistee is the shore town of Manistee county; it lies in latitude 44° 20′ north; it is about ninety miles north of Grand Haven, and one hundred and eighty-five by steamboat route from Milwaukee. Its present population is only three thousand, but its growth is very rapid, and the number of its inhabitants will soon be doubled.

The country back of Manistee is heavily wooded. The soil varies, but is principally a sandy loam. New saw-mills are being erected, and in one or two years Manistee will become probably the largest lumber market in the world. For the past six years navigation has been closed on an average eighty-seven days. There is very little float-ice off the mouth of the harbor, the current being sufficiently rapid to keep it clear. Vessels all pass within twelve miles of Manistee, and will find this a safe and convenient harbor of refuge when ice prevents them from making other ports. As a wooding point it will be an important aid to steam navigation. It will furnish an outlet for the products of a large tract of country five hundred square miles in extent, rapidly being opened and settled.

The Big Manistee river, which empties into Manistee lake, and from thence into Lake Michigan, is navigable for small boats for a distance of one hundred and fifty miles from its mouth, but navigation on it is almost entirely obstructed by logs being floated down to the mills.

I am very respectfully, your obedient servant,

A. MACKENZIE,
Captain United States Engineers.

Abstract of contracts for improving Manistee harbor, Michigan.

Contractors.	Nature of contract.	Price.
Gelley & Weston	12-inch timber, per M, board measure	$12 90
Do	3-inch plank, per M, board measure	14 00
Do	Piles, per lineal foot	8
Galen Eastman	Stone, per cord of 128 cubic feet	14 88
Do	Brush, per cord of 128 cubic feet	2 00
R. Nelson Gere	Iron bolts, per pound	4.9
Do	Iron spikes, per pound	4.9
H. Starke	Framing, per lineal foot of timber	15

Abstract of materials received and used, labor performed, and amount paid to contractors up to September 1, 1867, at harbor of Manistee, Michigan.

Materials received: Gelley & Weston, timber, pine, 4,925 lineal feet; other timber, 15,163 lineal feet; Galen Eastman, stone, 493 cords; R. N. Gere, iron, 33,027 pounds.

Materials used: Timber, 6,460 feet.

Labor performed: Framing, 6,460 feet; cribs placed, 5.

Contractors.	For what paid.	Amount paid.	Remarks.
Gelley & Weston	Timber	$2,798 67	Amount with 10 per cent., $8,555 72.
Galen Eastman	Stone	4,901 48	
Total		7,700 15	

A 25.

AUX BEC SCIES, MICHIGAN.

This harbor was fully discussed in your last yearly report, and the plans for its improvement were then given. They were to make a new cut seven hundred and fifty feet south of present outlet, two hundred feet wide, to protect the sides of the cut by close piling, to extend piers into Lake Michigan eleven hundred and twenty feet due west, and to dredge the entire channel to a depth of twelve feet.

This work was surveyed the present month by Mr. Hearding, assistant engineer, and party. The results of the survey show that the only change in plan required will be to extend the piers further into Lake Michigan, and increase the estimate for close piling and dredging. The north pier will be six hundred and seventy-two feet (twenty-one cribs) in length, and the south pier eight hundred and thirty-two feet (twenty-six cribs) in length. There will be required five hundred and fifty feet of close piling, and eighty-five thousand cubic yards of dredging. The cost of this work at contract prices will be—

For pier work, 47 cribs	$103,400
For close piling, 550 feet	13,000
For dredging	30,000
Total	146,000
Present appropriation	98,541
Balance required	47,859

The contract requires the work to be finished in 1868. The total amount, $47,859, will be required during the next fiscal year.

The contractors, Messrs. Whitewood and Hubbell, of Detroit, commenced the work last winter, collecting materials, &c. As soon after the opening of navigation as practicable they commenced the dredging, and up to date have removed 40,000 cubic yards. They expect before the close of navigation to finish the cut, close-pile the channel, and sink fifteen cribs, (480 feet)

Frankford, or Aux Bec Scies, is thirty miles north of Manistee. Its nearest light-house is on Point Aux Bec Scies, or Point Betsie, as it is generally known. Betsie light is four and six-tenths miles north of the new channel; it is a fixed light of the fourth order, varied by flashes. Frankford is in the collection district of Michigan, and its nearest port of entry is Grand Haven.

Its imports for last year amounted in value to $4,000, and consisted of dry goods and lumber; its exports consisted of cord wood, and amounted in value to $120. The importance of this harbor is as a harbor of refuge. It is an exposed point, and in the vicinity of one of the most dangerous parts of the lake. All vessels bound up or down pass within five miles of the harbor. It will without doubt afford a safe anchorge during storms for many vessels yearly, and will save more to commerce in a short time than has been expended in its construction. A large tract of land around Frankford, extending fifty miles north and south and seventy-five miles east, is being settled slowly. This country abounds in hard timber, and the soil is good.

Betsie river is unnavigable except for small flat-boats; logs cannot be floated down. There is but one small saw-mill on the little lake, and that seldom in operation. The great difficulty in obtaining logs in great quantities will prevent this point from ever becoming a great lumber market.

Bentzonia, a small, religious village, ten miles inland on the Betsie river, is the only settlement of any importance in the vicinity.

Crystal or Cass lake, two miles north of Frankford, is a large and beautiful sheet of water; it is only one-half mile from Lake Michigan, but many feet above it. It is surrounded by high hills, and has no visible inlet except the sides of the hills during rains. Near the middle it is several hundred feet in depth. It has an outlet into Betsie river, open at times, but generally closed. It is proposed by the inhabitants of the surrounding country to lower Crystal lake two feet to drain some valuable land now under water. Were this lake on a level with Lake Michigan, and a communication practicable, a magnificent harbor could be made.

I am, very respectfully, your obedient servant,

A. MACKENZIE,
Captain Engineers.

Colonel J. B. WHEELER,
Major Corps of Engineers U. S. Army,
Superintendent of Harbor Works, Milwaukee, Wisconsin.

Abstract of contracts for improving Aux Bec Scies harbor, Michigan.

Contractors.	Nature of contract.	Price.
Whitewood & Hubbell	12-inch timber, per lineal foot	$0 18
Do	3-inch plank, per M, board measure	20 00
Do	Piles, 30 feet long, oak, each	5 75
Do	Piles, 30 feet long, elm, each	2 75
Do	Stone, per cord of 128 cubic feet	17 00
Do	Brush, per cord of 128 cubic feet	4 50
Do	Slabs, per cord of 128 cubic feet	2 50
Do	Wrought-iron bolts, 1⅛ square, per pound	6
Do	Wrought-iron spikes, 1⅛ square, per pound	7½
Do	Driving piles, per pile	6 00
Do	Framing and building cribs	168 00
Do	Placing, sinking, and filling	30 00
Do	Dredging in common earth, sand, or soft clay, per cubic yard	35
Do	Dredging in hard clay or hard pan, per cubic yard	70

Abstract of materials received and used, labor performed, and amount paid to contractors up to September 1, 1867, *at Aux Bec Scies, Michigan.*

Materials received: Whitewood & Hubbell, timber, 30,885 feet; piles, 634; iron, 121,821 pounds.

Materials used: Piles, 23.

Labor performed: Dredging, 32,688 feet; piles driven, 23.

Amount paid: Whitewood & Hubbell, dredging, timber, &c., $25,159 38; amount with ten per cent., $27,954 86.

A 26.

OFFICE UNITED STATES ENGINEERS,
Milwaukee, Wisconsin, September 2, 1867.

COLONEL: In compliance with article five of your circular, dated July 20, 1867, as follows, viz: "Assistant W. T. Casgrain is assigned to the special superintendence of the surveys being or to be made by this office," I have the honor to present you a general report upon the several surveys made since August 10, 1866, at which time I reported to you for duty.

From that date to September 6, 1866, the time was occupied in making tracings of the following maps: Grand Haven, Muskegon, and St. Joseph's harbors, Michigan, Chicago harbor, Illinois, and Racine, Kenosha, and Sheboygan harbors, Wisconsin, which were surveyed under the direction of Colonel W. F. Raynolds, superintendent United States lake survey, in 1865; also, in making preparations, previous to taking the field, for making surveys of Manistee, White Lake, Muskegon, South Haven, and New Buffalo harbors, Michigan.

In obedience to your orders of September 6, 1866, I left Milwaukee for Manistee, Michigan, and made a survey of that place. The time occupied was from September 7 to October 2, 1866, the unfavorable state of the weather causing unexpected delay.

The survey was carried one-half (½) mile on each side of the harbor and the whole length of the river, one and a half (1½) mile to Manistee lake; then extended about three-fourths (¾) of a mile on each side of the entrance.

The details of the work accomplished by myself and party at that point are as follows, viz:

Number of triangulation stations built and occupied	26
Number of sounding stations built	106
Number of buoys placed out and located	21
Number of casts of the lead made	5,881
Number of lines of soundings run	353
Number of miles of soundings run	50.40
Number of theodolite horizonal angles measured	392
Number of theodolite vertical angles measured	178
Number of theodolite readings taken and recorded	680
Number of square miles of topography	1.50
Number of square miles of hydrography made	1 62
Number of miles run with stadia instruments for topography	7.30
Number of shore line chained and sketched	7.80
Number of observations to determine the true meridian	2

The map containing this survey was plotted on a scale of one inch to two hundred feet, in December, 1866, on a sheet of paper thirty-six by sixty inches, and embraces three hundred and twelve square inches of minute hydrography, and four hundred inches of topography.

A detail sheet of the mouth of the river, on a scale of one inch to one hundred feet, showing the pier work done by private enterprise at the mouth of the river, and about three hundred feet of shore line, on each side of them, was also plotted. Duplicate tracings of each of these were made, a copy sent to the engineer department, and the other furnished Colonel W. F. Raynolds, superintendent United States lake survey, Detroit, Michigan.

Your orders of October 2, 1866, directing me to proceed to Père Marquette and Pentwater, Michigan, to make a reconnoissance of each of these places, and then to White river, Michigan, my next field duty, was handed to me by Mr. James Southall on the following day. The survey of Manistee being completed, I immediately packed up all the instruments, surveying implements, &c., and left the same evening with my party for Pentwater, having been unable to procure a boat to land me at Père Marquette as desired in your instructions.

I landed at Pentwater, Michigan, at 11 p. m. October 3, and spent the next day in making a thorough reconnoissance of the entrance of the river and character of its bottom, as well as the general topography around the harbor and lake.

At 7 a. m. October 5th I left with party for White river, where I landed at 2 p. m. The survey of White river was commenced October 6, and closed on the 19th of the same month. The shore line and soundings on Lake Michigan were carried one-half (½) mile north of the mouth of the river and one and a quarter (1¼) of a mile south of it. The river was carefully measured and minute soundings taken from its mouth to its entrance into White lake, a distance of nearly one mile. The shore line of White lake was surveyed on each side of the river, three-fourths (¾) of a mile, and soundings taken at the entrance of the river and lake. I thought it necessary to take the levels on the narrow belt of land between White lake and Lake Michigan, to show the character of the ground on it, and enable you to make estimates for a channel across it should it be found advantageous.

The amount of work done at this point is as follows:

Number of triangulation stations	29
Number of sounding stations	83
Number of buoys placed out and located	18
Number of casts of the lead made	3,018
Number of lines of soundings run	226

Number of miles of soundings run	44.41
Number of theodolite horizontal angles measured	497
Number of vertical angles measured for topography	145
Number of theodolite readings made and recorded	576
Number of square miles of topography made	1.33
Number of square miles of hydrography made	1.48
Number of miles run with the stadia instrument for topography	11.11
Number of miles of shore line chained and sketched	5.70
Number of observations taken to determine the true meridian	2

The work of plotting this map was done in the field, on a scale of one inch to 300 feet, and a tracing from it sent to the engineer department.

During the month of January it was plotted on a scale of one inch to 200 feet, on a sheet of antiquarian paper, embracing 330 square inches of minute hydrography and 164 square inches of topography. A portion of the point between Lake Michigan and White lake was also plotted on a scale of one inch to 100 feet, to show the minute topography on the land and the soundings abreast of it, to the depth of 14 feet. Tracings of each of these were made and furnished Colonel Wm. F. Raynolds, superintendent United States lake survey, Detroit, Michigan.

Mr. E. Dumais, draughtsman, reported to me for duty at White river, and handed me your orders of October 17, 1866, directing me to proceed immediately upon the completion of the survey of White lake to Muskegon, my next field duty.

I closed the work at White lake on the 19th, and on the 20th left with my party, instruments, and equipage for Muskegon, fifteen miles south of White river, with propeller Brittan, where after a two hours' ride I landed safely.

The work at this point was only to make a thorough examination of the mouth of the river, take the soundings outside of the pier to the depth of 24 feet, and notice whatever changes had occurred since the last survey, made under the direction of Colonel Wm. F. Raynolds in September, 1865.

I was delayed at that point from October 20th to November 4th on account of stormy weather. The fair weather was devoted to the field work, while the stormy days were occupied in making computations and plotting the maps of Manistee and White river. The length of the north pier I found to be 1,454 feet instead of 1,404 feet, as shown on the map of the survey of 1865.

Below will be found a statement of the amount of work performed at this point:

Number of triangulation stations erected and occupied	4
Number of sounding stations built	69
Number of buoys placed out and located	10
Number of casts of the lead made	1,983
Number of lines of soundings run	124
Number of miles of soundings run	15.33
Number of theodolite horizontal angles measured	52
Number of vertical angles measured for topography	15
Number of theodolite readings taken and recorded	86
Number of miles run with the stadia instrument for topography	1.03
Number of miles of shore line chained and sketched	1.25

A map of this survey was plotted in the office in March, 1867, on a scale of one inch to 200 feet, embracing 240 square inches of topography and ninety square inches of hydrography. A map on a scale of one inch to 100 feet, showing the piers, soundings and character of the bottom at the entrance of the river and the soundings outside of it to the depth of fourteen feet, was also made. Tracings of each of these maps were made and sent to the engineer department in December, 1866, together with a report of exports and imports for the past year and estimates also for improving the harbor.

My next field duty, by your orders of November 2, was South Haven, Michigan. On November 5th I left Muskegon for Grand Haven, where I found Captain Squier waiting for me, who had orders to take my party to South Haven. I at once proceeded to that place and landed on the morning of the 6th.

The survey was immediately begun and occupied nine days; i. e., until the 14th of the same mouth. The hydrography in Lake Michigan was limited to the depth of nineteen feet, and I carried the soundings up the river as far as the bridge, situated three-fourths of a mile from the mouth. The shore line was run with the theodolite, chained and sketched accurately a distance of half a mile on each side the mouth of the river. The topography surrounding the river was also sketched, and the height of the ground determined by the stadia instrument to show the contour of the hills. The amount of work done at this place is as follows, viz:

Number of triangulation stations erected and occupied	9
Number of sounding stations built	51
Number of buoys placed and located	12
Number of casts of lead made	1,981
Number of lines of soundings	200
Number of miles of soundings	21.26
Number of theodolite horizontal angles measured	185
Number of theodolite vertical angles measured	126
Number of theodolite readings taken and recorded	330
Number of square miles of topography sketched	0.50
Number of square miles of hydrography made	0.78
Number of miles run with the stadia instrument for topography	6.01
Number of miles of shore line chained and sketched	2.39
Number of observations to determine the true meridian	3
Number of compass readings to ascertain the magnetic variations	24

The survey was plotted in pencil in the office during the month of December, 1866, and finished in April, 1867. It embraces 112 square inches of minute hydrography and 130 square inches of minute topography. The mouth of the river was plotted on a scale of one inch to one hundred feet, to show fully the nature and capacity of the harbor, as well as the position of the old pier work done by private enterprise, and the soundings outside to the depth of fourteen feet. A tracing of each of these was made from pencil notes in December, and sent to the bureau. Also a report of the amount of business transacted, together with the exports and imports for the past year. Estimates for the improvement of the harbor were likewise made and submitted to you.

The survey of South Haven was completed on the 14th of November, and on the 15th I left with my party for New Buffalo, where I arrived on the 17th of the same month.

A copy of the survey of this harbor made, under the direction of Colonel J. D. Graham, corps of engineers United States army, in September, 1857, was forwarded to me in October, 1866, at Muskegon, with orders to make a thorough reconnoissance, and show the changes that had taken place since this last survey; the season being too far advanced to make a new one. I made a few measurements to determine the course of the river, and to show the change of the shore line. I found the outlet of the river removed seven hundred feet west of its original course, having cut into the adjoining hills on the south side about 120 feet. At a point half a mile east of the old channel the accretions or sand deposits were first noticed, gradually increasing in width as you advanced westward, until abreast of the old outlet, which was found to be two hundred feet in width and diminishing gradually towards its present course.

The depth of the river was from two to three feet, and scarcely any perceptible changes had occurred in Lake Pottawatomie.

I also visited the spot chosen by the late Colonel J. D. Graham, corps of engineers United States army, for a thorough cut across the point between Lakes Pottawatomie and Michigan, and the only changes noticed were the sand dunes, which had been blown into different shapes from those indicated on the map.

Having completed the reconnoissance of New Buffalo on the 21st of November, I discharged my party and left with my assistant for Milwaukee, Wisconsin, to report at the office, where I arrived on the 22d, and at once started the computation and projection of the field notes.

On the 17th of August, 1866, Captain Alexander Mackenzie made a reconnoissance of the harbor of Grand Haven, to ascertain the changes on the outer bar since the last survey of 1865, and took a few soundings at that point, which were plotted on the tracing of Grand river.

A survey of Black Lake harbor, Michigan, was made by Captain Alexander Mackenzie, corps of engineers United States army, and the following amount of work performed between the 4th and 20th of October, 1866, viz:

Number of triangulation stations erected and occupied	12
Number of sounding stations built	21
Number of buoys placed out and located	19
Number of casts of the lead made	1,344
Number of lines of soundings run	82
Number of miles of soundings run	8.80
Number of theodolite horizontal angles measured	63
Number of vertical angles measured	122
Number of theodolite readings traced and recorded	126
Number of square miles of topography	0.35
Number of square miles of hydrogaphy	0.30
Number of miles of shore line chained and sketched	2.59
Number of observations to determine true meridian	1
Number of compass readings taken	45

The map of this survey was projected on a scale of one inch to two hundred feet, in November, 1866, by J. T. Baker, then draughtsman on the work, and embraces 118 square inches of hydrography and ninety square inches of topography. The channel, piers, and a portion of the shore line on each side of the entrance, as well as the soundings to the depth of fourteen feet, were plotted on a scale of one inch to one hundred feet. Duplicate tracings of this map were made and a copy sent to the engineer department in November, 1866.

A reconnoissance of each of the harbors of Kenosha and Manitowoc, Wisconsin, was made in October, 1866, by Lieutenant James B. Quinn, corps of engineers United States army, showing the changes which have taken place since last surveyed. Sketches of these reconnoissances were made by the same officer in November.

By permission of the engineer department it is contemplated to make a new survey of these harbors this season; the delay has been occasioned by the amount of office-work on hand previous to making the annual report. It is hoped, however, that the field-work will soon be resumed, and these surveys made before the close of the season.

On the 25th day of March, 1867. I was ordered to make an examination of the Milwaukee harbor, and take soundings to the depth of twenty-one feet, to ascertain the position and character of a bar reported forming abreast of it. Preparations were at once made, stations erected, and measurements taken to forward the work, as it was desirable that soundings be taken before the spring freshets took place, to ascertain the changes the current would produce. Owing to the unfavorable state of the weather the soundings could not be taken till the second of April, causing some eight days' delay. From June 24 to July 2, another examination was made to show the changes since the last one. A bar 10.8 feet for the shallowest depth of water was found to exist 300 feet east of the light-house crib, located at the outer end of the north pier, tending nearly south-southeast and extending as far as the line of the north pier, at which point is found thirteen feet of water. This bar is shown on the sketches which have been made in April and July, a copy of which accompanies this report.

The amount of work done on both of these examinations is as follows, viz:

Number of sounding stations erected	102
Number of buoys placed out and located	14
Number of casts of the lead made	1,385
Number of lines of soundings run	72
Number of miles of soundings run	4.5
Number of theodolite horizontal angles measured	24
Number of theodolite readings taken and recorded	48
Number of miles of shore line chained	0.25

From the 9th to the 19th of April, 1867, Captain Alexander Mackenzie made a survey of the harbor of Michigan City, and accomplished the following amount of work, viz:

Number of triangulation stations built and occupied	12
Number of sounding stations and stakes	172
Number of buoys placed out and located	12
Number of casts of lead made	2,437
Number of lines of soundings run	167
Number of miles of soundings run	17.27
Number of theodolite horizontal angles measured	72
Number of vertical angles for topography	92
Number of readings taken and recorded	144
Number of miles of shore line chained and sketched	4.86
Number of observations to determine the true meridian	2
Number of compass readings made	24

The computations and projections of this map were made in May last, by J. T. Baker, draughtsman, and embrace 154 square inches of topography and 178 inches of hydrography.

A portion of the harbor, including the piers built by the city, and showing the soundings, shore line, &c., was plotted on a general scale of one inch to one hundred feet. A tracing of this map has been made to accompany the annual report.

On the fifth of May I received orders from you to organize a party and proceed to Racine, Wisconsin, to make a survey of the reef situated two miles east-southeast of the harbor, and left the office with my party, instruments, and equipage on the following day, and commenced operations forthwith. In consequence of the prevailing winds, frequently accompanied by rain, much delay was experienced in prosecuting this survey. Our boat—a borrowed one—ill calculated for the work, being small and crank, which often compelled me to seek refuge in the harbor when the wind at all freshened. It was obvious that, in order to push the work forward without delay, a steam-tug was indispensable, but the rate for services charged were so exorbitant that I was forced to dispense with them as much as possible. Another great delay was occasioned by the carrying away of a water station in a gale on Sunday, the 12th of that month, which had been placed on the reef in nine feet of water. It consisted of three pieces of timber, eight inches square, thirty-eight feet in length, put together in the form of a tripod, and strongly bolted and braced. At twenty feet from the base a platform was fixed, upon which was placed about three-fourths of a cord of stone to anchor it. Above the stone was a small platform, sufficiently large to enable one person to observe with an instrument, and locate the buoys placed out. Three of these stations were carried away during the time of the survey, which occupied one month.

The amount of work performed at this place is as follows, viz:

Number of triangulation stations built and occupied	10
Number of sounding stations built	86
Number of buoys placed and located	30
Number of casts of lead taken with steamer	1,456
Number of casts of lead taken with small boat	4,846
Number of lines of soundings run with steamer	36
Number of lines of soundings run with small boat	373
Number of miles of soundings run with steamer	71.25
Number of miles of soundings run with small boat	185.30
Number of theodolite horizontal angles measured	777
Number of vertical angles measured	12
Number of theodolite readings taken and recorded	744
Number of square miles of topography	2
Number of square miles of hydrography	9.87
Number of shore line chained and run	4.50
Number of observations to determine true meridian	2

The computation of the triangulation was made immediately after returning from the field, on June 5th, the notes plotted in pencil, and the map placed in the draughtsman's hands on July 15th, and is nearly completed. It is plotted on a scale of one inch to eight hundred feet, or one ninety-six-hundredths, and comprises four hundred and twenty square inches of topography, and six hundred square inches of hydrography. A copy of this map will also be made to accompany your annual report.

On May 18, 1867, a surveying party, under the direction of J. W. Judson, was organized and sent to Menomonee river, Green Bay, to make a survey of its mouth, with a view of making estimates for improving the same. On account of unavoidable delay from bad weather, and difficulties encountered by loss of buoys, stations, &c., which were carried away by lumber, rafts, and scows constantly passing to and fro, the work progressed slowly, and it was not until the 5th of August that Mr. Judson completed the survey, when he was ordered to report to the office, where he arrived on the 8th of the same month.

The work performed by Mr. Judson was not found sufficiently accurate to warrant satisfactory results, and his services, in consequence, were no longer required.

The amount of work performed by Mr. Judson on the survey of Menomonee is as follows, viz:

Number of sounding stations built	26
Number of buoys placed out and located	17
Number of casts of the lead made	2,250
Number of lines of soundings run	193
Number of miles of soundings run	32
Number of theodolite horizontal angles measured	320
Number of theodolite readings recorded	395
Number of square miles of topography	0.41
Number of square miles of hydrography	1.10
Number of miles of shore line run	3.75
Number of observations to determine true meridian	1

Assistant W. H. Hearding, formerly attached to the United States lake survey, reported here for duty about July 1, and has been detailed to project the map of Menomonee from the notes taken by Mr. Judson, and a copy of it will be ready to accompany your report.

In compliance with your orders of July 3, I proceeded with a leadsman and chainmen to the mouth of Kalamazoo river to make a survey of that place for the purpose of making estimates for its improvement. We reached that place on the evening of the 6th, and commenced the survey the following morning, completing it on the 13th of July, and left immediately for Milwaukee, Wisconsin, reporting at this office on the 14th, the following day.

The amount of work performed during these six days is as follows, viz:

Number of triangulation stations built and occupied	19
Number of sounding stations built	46
Number of buoys placed out and located	20
Number of casts of lead made	2,858
Number of lines of soundings made	217
Number of miles of soundings made	25.5
Number of theodolite horizontal angles measured	367
Number of vertical angles measured for topography	51
Number of theodolite readings taken and recorded	512
Number of miles measured with the stadia instrument	9.25
Number of miles of shore line run and sketched	3.75
Number of observations made to determine true meridian	2
Number of compass readings taken to ascertain the variations	24

The work of computing and plotting the notes of this survey was done at the office in July, and the map has been projected in pencil on a scale of one inch to two hundred feet; a tracing of it has also been made to accompany your annual report.

On the 29th of July, 1867, Assistant W. H. Hearding received orders from you to proceed to Aux Becs Scies harbor and make a new survey of that place, so as to facilitate the improvements now being made, and verify the accuracy of the previous surveys made by Lieutenant O. M. Poe, corps of engineers United States army, in 1859, and the one furnished you by Colonel Cram, corps of engineers, which had been made in 1865. A great many discrepancies were found to exist between the survey of Lieutenant Poe and that furnished by Colonel Cram, and involved the necessity of making an accurate one. He left on the evening of the 29th, and arrived at Aux Becs Scies on the 2d day of August, commencing the survey on that day and closing it on the 8th day of the same month.

He reports the following amount of work performed during that time, as follows, viz:

Number of triangulations built and occupied	25
Number of sounding stations built	28
Number of buoys placed out and located	20
Number of casts of the lead made	1,975
Number of lines of soundings run	175
Number of miles of soundings run	31.00
Number of theodolite horizontal angles measured	454
Number of vertical angles for topography measured	54
Number of theodolite readings taken and recorded	541
Number of square miles of topography sketched	0.33
Number of square miles of hydrography made	0.75
Number of miles run with the stadia for topography	3.01
Number of miles of shore line run and sketched	2.02
Number of observations to determine the true meridian	1

Assistant Hearding returned from the field on the 13th of August, since which time he has made the computations of the field-notes and projected them on a scale of one inch to 200 feet, and are now plotted in pencil.

An abstract of the work done at each of the harbors surveyed since August, 1866, is attached to this report, and shows the total amount performed during the past year, under the head of Appendix A.

OFFICE-WORK.

The months of December, 1866, January, February, March, and April, 1867, were devoted to office-work. During that time the computations and projection of all the season's field-work were made, and the notes taken of each harbor plotted on a general scale of one inch to 200 feet. Wherever improvements were contemplated detail drawings of one inch to 100 feet have been made to accompany the report and estimates of last year.

The following are the number of surveys which have been projected and drawn, viz:

One map of Black lake, on a scale of one twenty-four-hundredth, the details on one twelve-hundredth; also, duplicate tracings of each made.

One map of Manistee, on a scale of one twenty-four-hundredth, the details on one twelve-hundredth; also duplicate tracings of each made.

One map of White river, on a scale of one twenty-four-hundredth, the details on one twelve-hundredth, and a tracing made also.

One map of Muskegon, on a scale of one twenty-four-hundredth, the details on one twelve-hundredth, and a tracing made.

One map of South Haven, on a scale of one twenty-four-hundredth, the details one twelve-hundredth, and a tracing made.

One tracing of New Buffalo harbor, from survey made in 1857, under the direction of Colonel J. D. Graham, corps of engineers United States army, to which were added the changes from the reconnoissance made in November.

One tracing of Pentwater harbor, as surveyed under the direction of Colonel W. F. Raynolds, corps of engineers United States army, and superintendent United States lake survey in October, 1866, to which was added the topography as sketched by myself in October, 1866.

One tracing of Père Marquette, as surveyed under the direction of Colonel W. F. Raynolds, superintendent United States lake survey in October, 1866.

A report and estimates for the improvement of each of these harbors was made by Captain Alexander Mackenzie and Lieutenant James B. Quinn, corps of engineers United States army, and myself, and submitted to you in December last.

Besides the above, maps, plans, and specifications of crib-work and close piling were also made as follows, viz:

One map in water colors, containing drawings of crib-work for piers on Lake Michigan, as described and adopted by Brevet Colonel J. B. Wheeler, major corps of engineers United States army, was drawn by J. T. Baker, draughtsman. Six tracings of this map were also made for distribution to parties awarded contracts.

One map in water colors, containing drawings of crib-work for Chicago harbor, as designed and adopted by Brevet Colonel J. B. Wheeler, major of engineers United States army, was also drawn by J. T. Baker, draughtsman, and duplicate tracings of this map made.

One map in water colors, containing a plan of pier work as designed and adopted by Brevet Colonel J. B. Wheeler, major corps of engineers United States army, for the improvement of the harbor of St. Joseph, Michigan, was drawn by J. T. Baker, and duplicate tracings of it made.

The notes and soundings of the survey of Michigan City were plotted on a scale of one inch to two hundred feet, and the map drawn partly by J. T. Baker, draughtsman, who was discharged on July 6 for neglect of duty. The map was then completed by Mr. Dumais.

A map of the survey of Racine reef has been drawn on a scale one inch to eight hundred feet, and will be completed in a few days. A copy of it will be ready for your annual report.

The field notes of the survey made in July of Kalamazoo river have all been plotted on a scale of one inch to two hundred feet, and a tracing of this map made to accompany your report.

Aux Bec Scies survey, made in August by Assistant W. H. Hearding, has been projected in pencil on a scale of one inch to two hundred feet, and will be completed as soon as the season's field-work is over.

Assistant Hearding has been engaged since his return from the field on the map of Menomonee river, which he has projected on a scale of one inch to two hundred feet. He is now engaged in making a tracing of this map, which will be completed for your report.

Before closing this report I wish to tender my sincere thanks to Assistant Hearding for the efficient manner in which he has accomplished his work, and my indebtedness to him in assisting me to make this report.

Attached to this will be found, in Appendix B, report and estimates for the improvement of Kalamazoo and Menomonee rivers, Michigan.

I am, colonel, very respectfully, your obedient servant,

WM. T. CASGRAIN,

Assistant and Superintendent of Surveys.

A 27.

Report and estimates on Kalamazoo river.

This river takes its rise in the southern part of Michigan, and after a circuitous course of about three hundred miles, empties into Lake Michigan about midway between Grand Haven and St. Joseph. During its course several falls of considerable extent occur, furnishing a number of water-powers of respectable capacity, and thus inducing a large amount of manufacturing, which will largely increase as the country grows older. The last and largest of these falls is at Allegan, a town of nearly three thousand inhabitants, twenty-five miles by land and fifty miles by river from Lake Michigan. Previous to settlement, the entire country traversed by it was densely covered with forests of pine and hard wood. The first settlement made in the country, which bears the same name as the town, was about 1830. The town was commenced a few years later—about 1835. The first business entered upon was the manufacture of lumber, and for several years those engaged in it were blessed with prosperity. The financial crisis of 1837 swept over them, and fair prospects received a sudden and discouraging blow, resulting in the suppression of operations by nearly all the mills.

About 1843 business began to revive, and Allegan has since had a comparatively prosperous career. Its chief growth, however, has been within the last five years. The volume of water in the river is quite large, and at Allegan takes a fall of nine feet, giving a very valuable power. This has already been improved, and each year adds to the number of manufacturing establishments. The manufacture of pine lumber is being somewhat superseded by that of hard wood, which finds a ready market at home and in Chicago.

The town of Allegan has a post office, two churches, two hotels, a large school-house, nineteen dry goods, hardware, groceries, drug, and crockery stores, one banking house, and three flouring mills, with a capacity of 1,200 bushels per day. These mills find an ample supply of wheat in the surrounding country without importing, and their flour, except custom work, is shipped to Chicago; about 300 barrels are forwarded weekly.

The presence of large tracts of the finest hard-wood timber of various kinds in Allegan county has induced parties to give considerable attention to ship-building; since 1862 they have built two propellers, two river steamers, two tugs, two schooners, and seven lumber barges, at a total cost of $177,500.

The connection from Allegan to the mouth of the river is made by a daily line of river boats; leaving Allegan in the morning, a ride of six or seven hours brings you to the thriving villages of Saugatuck and Douglas, situated on either side of Kalamazoo lake, a beautiful inland sheet of water, six miles in length and one and a half mile in width, and about three miles from the outlet of the river in Lake Michigan. The larger of these is Saugatuck, situated on the north side of the river, and contains a population of over one thousand inhabitants. The chief business is the manufacture of lumber in various ways, the supply of logs being derived from the pineries along the river between this place and Allegan, and the country back. Saugatuck has a post office, two churches, two hotels, sixteen stores, eight saw-mills, one tannery, and a large school-house, just completed at a cost of $10,000; it occupies a beautiful situation overlooking Kalamazoo lake, and is a credit to the young village.

Douglas is situated on the south side of the lake; its population is about six or seven hundred inhabitants; it has two steam saw-mills and a large tannery, which turns out about 10,000 hides annually.

Singapore, a small village of two or three hundred inhabitants, is situated about one mile from the mouth of the river, on the north bank; has two steam saw-mills, two stores, and a few dwellings.

Besides the various branches of business enumerated above, there are numerous manufactories of furniture, wagons, &c., which find at the extensive water-power on the river a congenial field for operations, and when means of transportation are permanently insured, they will largely increase.

One of the great sources of wealth for the country bordering on the lake in this part of Michigan will be, and in fact now is, the fruit crop. The sandy soil and lake breezes seem particularly fitted for nourishing fruit trees, more especially the peach; already large orchards abound, and fruit-men are every year investing capital and enlarging the business.

The amount of business done on the river has, through the kindness of Mr. F. B. Stockbridge, been furnished me. It contains a full statement of the amount of lumber, shingles, &c., manufactured at all the points on the river and shipped to Chicago, Milwaukee, Racine, Kenosha, and various other ports during the season of 1867, and will serve to show what other development might arise, should the navigation be made safe and certain.

	Value.
Lumber made by 14 water mills and 19 steam mills, 70,000,000 feet	$840,000 00
Shingles made by 23 shingle mills, 85,000,000	300,000 00
Sides of leather, 60,000, at $6	360,000 00
Flour, 70,000 barrels, at $10	700,000 00
Potatoes, 4,000 barrels, at $2 25	10,000 00
Apples, 10 000 barrels, at $3	30,000 00
Peaches, 25,000 packages, at $1	25,000 00
Hemlock bark, 5,000 cords, at $5	25,000 00
Wood, beach and maple, 10,000 cords, at $3	30,000 00
Railroad ties, 40,000 cords, at 50 cents	20,000 00
Hewed timber, 500,000 feet, at $10	5,000 00
Turned stuff for bedsteads, chairs, &c	15,000 00
	2,360,000 00

AMOUNT AND VALUE OF IMPORTS.

250 tons of mixed merchandise, valued at, probably..........	$500,000 00
30,000 hides, valued at, probably..........................	240,000 00
	740,000 00

IMPROVEMENTS AT THE MOUTH OF THE RIVER.

The existence of two large bars across the mouth of the Kalamazoo river has heretofore greatly impeded the growth of the villages and towns on the river, and of the entire country. Its natural market is Chicago, and although a railway is now in course of construction from the town of Kalamazoo, situated on the line of the Michigan Central railroad, which will do a large business, yet the lake must eventually furnish a means for the exit of the chief heavy freight. The realization of this fact led to active measures for the removal of the bar. A company with a subscribed capital of $30,000 was formed, principally of the manufacturers and shippers, and nearly the whole amount spent in improvements. They have built two piers or jettees, consisting of 500 feet on the north side and 1,575 feet on the south side, of slab-work, placed together firmly, and are the best of the kind I have ever seen. These piers have confined the current, which has kept a channel of seven feet of water open this season. One result of the present work has been to allow the entrance of a fair class of lake steamers, and the enterprise of several parties has already established the propeller line with Chicago by the new and staunch propeller Ira Chaffee, which makes tri-weekly trips. She was built at Allegan and commenced her trips in May last.

The amount of business done at this point, together with the number of vessels which frequent that thoroughfare, (it being a central point for those running to Chicago and Milwaukee on the west shore, and Grand Haven and St. Joseph on the east shore,) necessitates the improvement of the harbor, of which there are few on Lake Michigan which could afford, with comparatively a small expenditure, better shelter during the prevailing autumnal storms. To make transportation safe and certain is to increase the value and results of human industry, and the attention of the government should be brought to bear on that fact.

PROPOSED IMPROVEMENTS.

Near the village of Singapore, where the river makes a bend, and on the line A B shown on the map accompanying this report, is a low piece of ground showing the probable outlet of the river at some remote period. This sort of gulley is about 400 to 500 feet in width, and the ground on either side of it is rolling, and ten to fifteen feet higher. The distance across this neck of land is 990 feet, and the average height above the lake surface is about seven feet. It might be true economy, for a permanent work, to cut across this neck of land and make the improvement at that point; but on account of the improvements already made at the present entrance of the river which are available, estimates for opening this channel were not made, the expenditure being deemed too great.

The estimates made out and submitted consist in improving the present entrance, the south pier, 416 feet, to the depth of twelve feet, and the north pier, 1,632 feet, also to a depth of twelve feet; these piers to be parallel to each other and 200 feet apart. Dredge a channel between them to the depth of twelve feet; also cut a channel in the bay 200 feet wide and twelve feet deep, to connect with the deep water near the first bend; all of which is shown by red lines on the accompanying map.

By making such improvements a good harbor of refuge can be made, which will be of great benefit to the large fleet of vessels frequenting the head of Lake Michigan, as well as improving the local trade.

A.—*Estimated cost of one crib,* 32′ × 25′ × 20′.

3,353 feet square timber, at 20 cents per lineal foot	$670 60
288 feet 3-inch plank, board measure, at $15 per M	4 32
3,938 pounds iron bolts, at 10 cents per pound	393 80
6 pounds iron bolts, at 10 cents per pound	60
89 cords of stone, at $16 per cord	1,424 00
10 cords of brush or slabs, at $2 50 per cord	25 00
Labor of framing and placing 3,353 feet, at 20 cents	670 60
	3,188 92
Add ten per cent. for contingencies	318 89
Total cost	3,507 81

B.—*Estimated cost of one crib,* 32′ × 20′ × 17′.

2,368 feet square timber, at 20 cents per lineal foot	$473 60
288 feet 3-inch plank, board measure, at $15 per M	4 32
3,554 pounds iron bolts, at 10 cents per pound	355 40
6 pounds iron spikes, at 10 cents per pound	60
56 cords of stone, at $16 per cord	896 00
6¾ cords of brush, at $2 50	16 88
Labor of framing and placing 2,368 feet, at 20 cents per lineal foot	473 60
	2,220 40
Add 10 per cent. for contingencies	222 04
Total cost of crib	2,442 44

Estimated cost of building 2,048 *feet of crib work, or sixty-four cribs, for improving Kalamazoo harbor.*

50 cribs, at $2,442 44, for north pier	$122,122 00
12 cribs, at $2,442 44, for south pier	29,309 28
2 cribs, at $2,770 15, for outer ends of piers	7,015 62
	158,446 90

C.—*Estimated cost of dredging the harbor of Kalamazoo to place the proposed cribs and the channel between them to the depth of twelve feet.*

To excavate 69,329.34 cubic yards outside to place cribs and open a channel 200 feet wide, at 40 cents	$27,731 73
To excavate 32,600 cubic yards inside the river to deepen the channel to 12 feet and 200 feet wide, at 40 cents per yard	13,040 00
	40,771 73
Add 10 per cent. for contingencies	4,077 17
	44,848 90

Recapitulation of estimates and costs.

To build 2,048 feet of crib work	$158,446 90
To dredge 101,929.34 cubic yards	44,848 90
Total cost	203,295 80

The town of Saugatuck is in the collection district of Grand Haven. It is not a port of entry. There is a light-house of the sixth order on the north bank of the river, situated on a rise of 18 feet. Its focal plane is 53 feet above the lake surface, and visible a distance of ten miles. It was rebuilt in 1859, having been washed away twice prior to that time.

I am, colonel, very respectfully, your obedient servant,

WM. T. CASGRAIN,
Assistant and Superintendent of Surveys.

A 28.

MENOMONEE RIVER.

This river takes its source in the "*Lac Vieux Desert,*" situated in the northern part of Michigan, and is the boundary line between the States of Michigan and Wisconsin for a distance of nearly 400 miles by the trend of the river. It has many tributaries, all of which are well adapted for rafting purposes, and is considered the best lumbering district of Michigan and Wisconsin. This river empties into Green bay, about half way between Green Bay City and Esconaba, situated in little bay Noquette, which is the terminus of the Esconaba and Marquette railroad. There is a daily line of steamers from Green Bay City to Esconaba, also from Green Bay City to Menomonee. The steamers plying between the last places are of a very light draught and adapted to the navigation of the Menomonee river, where a depth of six feet is found on the outer bar. The west shore of Green bay is frequented by a large fleet of vessels engaged in carrying lumber to Chicago and Milwaukee. There are a number of points on the bay where large shipments of lumber are made; these are Big and Little Suamico, Pensaukee, Oconto, Peshtigo, Menomonee, Cedar and Ford rivers, also Chambers's island. Below is a table showing the amount of lumber shipped from each of the above points.

	Feet.	Value.
Little Suamico	60 millions	$720,000
Big Suamico	78 millions	936,000
Pensaukee	75 millions	900,000
Oconto	100 millions	1,200,000
Peshtigo	85 millions	1,020,000
Menomonee	90 millions	1,080,000
Cedar river	40 millions	480,000
Ford river	22 millions	264,000
Chambers's island	15 millions	180,000
Total	565 millions	6,780,000

The large fleet of vessels that is required to carry this lumber need a sheltering place at some point on the bay to run to during the severe storms, most of which are from the northeast. Vessels at anchor close to the shore often find it a difficult matter to make an offing on account of the shoal water and the banks of Peshtigo and Oconto, which they have to keep clear of. It may be thought that they can make a lee under Chamber and Green islands, but with wind from the northeast it is impossible.

On the east shore of Green bay, good natural harbors can be found at Little and Big Sturgeon bays, Egg harbor, Fish creek, and Horseshoe island, for protection during the northeasterly gales.

The Peshtigo Company have expended large sums of money to construct a harbor at the mouth of the Peshtigo river, but it fails to meet the wants of the shipping interests in that locality during the severe autumnal storms.

The bar, about one mile north of the river, extends out into the bay about seven miles before nine-feet water is reached, and thus cuts off vessels from making that harbor during northeasterly gales. It will be seen by a glance at the map that a vessel desiring to make the harbor during a heavy blow from northeast or east-northeast would be compelled to run down below the point of the Peshtigo bar, and then haul close to windward to make the harbor at all; a feat very difficult for the best navigators to perform. There are 120 miles on the west shore of the bay without any harbor whatever, and Menomonee is about half-way between Green Bay and Esconaba, and a central point for a harbor.

Through the kindness of Mr. E. S. Ingalls, I have been furnished a table showing the amount of business done at the mouth of this river, which I give in this report.

Statement of lumber, &c., shipped from Menomonee for year 1867.

Article.	Quantity.	Value.
Lumber	90,000,000 feet.	$1,080,000
Shingles	25,000,000 feet.	1,000,000
Lath	12,000,000 feet.	48,000
Pickets	1,000,000 feet.	12,000
Square timber, hewn	2,000,000 feet.	300,000
Railroad ties	50,000 feet.	25,000
Fish	1,500 bbls.	15,000
Amount exported		1,580,000

Two hundred tons mixed merchandise, valued at about $400,000.

The number of arrivals of large vessels for 1867 were 400; steamers, 175; transient vessels, 25.

There are also three tugs plying on the river to supply the wants of vessels and towing rafts, &c.

The population and business near the mouth of the river is contained in three villages: Menekaunee and Marinette, on the south or Wisconsin side, and Menomonee, on the north or Michigan side. Menekaunee is in the town of Marinette, at the mouth of the river, directly opposite Menomonee. Marinette is one mile up the river. Menomonee is on the neck of land lying between Green bay and the river; is the county seat of Menomonee county, which was organized in 1863; has a post office, two hotels, and a printing office, publishing the *Menomonee Herald*, and ten steam saw-mills. The entire population of the three villages is estimated at about 3,000 inhabitants.

The depth of the river at the entrance is only six feet, and but few vessels can enter, and those of very light draught. The principal business done on the river is lumber, all of which is shipped to Chicago and Milwaukee. One foundry and a door and sash factory are now in progress of erection.

To improve the present channel of the river is impracticable, on account of the shifting sand-bar across it. It is, therefore, proposed to cut across the neck of land between Green bay and Menomonee river, and run two parallel piers on a due east course a distance of 1,375 feet on the north side, and 1,275 feet on the south side, and dredge a basin inside the river to the depth of twelve feet, as shown on the map accompanying your annual report.

The benefit derived from such improvement would be the general commerce on Green bay and Lake Michigan, and the local trade of Menomonee, besides developing the resources of the country in that section of the State, and making a good harbor of refuge.

Estimates for the improvements, as above described, are herewith respectfully submitted.

A.—*Estimated cost of one crib*, 32′×25′×20′

3,353 feet square timber, 12 inches, at 24 cents per lineal foot...	$804 72
288 feet 3-inch plank, at $15 per thousand..................	4 32
3,938 pounds iron bolts, at 10 cents per pound...............	393 80
6 pounds iron spikes, at 10 cents per pound..................	60
89 cords stone, at $10 per cord............................	890 00
10 cords brush, at $2 50 per cord...........................	25 00
Labor of framing and placing 3,353 feet, at 24 cents per lineal foot...	804 72
	2,923 16
Add ten per cent. for contingencies.........................	292 31
Total cost..	3,215 47
To build two cribs, 32′×25′×20′ at $3,215 47, each........	$6,430 94

B.—*Estimated cost of one crib*, 32′×20′×17′.

2,368 feet 12-inch square timber, at 24 cents per lineal foot.....	$568 32
288 feet 3-inch plank, at $15 per thousand..................	4 32
3,554 pounds iron bolts, at 10 cents per pound...............	355 40
6 pounds iron spikes, at 10 cents per pound..................	60
56 cords stone, at $10 per cord............................	560 00
6¾ cords brush, at $2 50 per cord...........................	16 88
Labor of framing and placing 2,368 feet, at 24 cents per lineal foot...	568 32
	2,073 84
Add ten per cent. for contingences.........................	207 38
Total cost..	2,281 22
To build 84 cribs, 32′×20′×17′ at $2,281 22, each.........	$191,622 48

C.—*Estimated cost of close-piling* 655 *feet to protect the sides of the cut from abrasion.*

For 16,375 feet piles, 25 feet long, at 10 cents per lineal foot.....	$1,637 50
For 1,310 feet of capping, 12 inches square, at 24 cents per lineal foot...	314 40
For 2,620 feet of stringers, 6 inches by 12 inches, at 12 cents per lineal foot..	314 40

For driving 720 piles, at $2 each	$1,440 00
For 65 cross-ties, 14 feet long, 12 inches square, 910 feet, at 24 cents per lineal foot	218 40
For 13,680 pounds of 1½-inch iron bolts, 30 inches long, at 10 cents per pound	1,368 00
For 2,433 pounds of $1\frac{1}{10}$-inch iron bolts, 12 inches long, at 10 cents per stringer	243 30
For framing and bolting 3,530 feet, at 12 cents per lineal foot	423 60
	5,959 60
Add 10 per cent. for contingencies	595 96
Total cost	6,555 56

D.—*Estimated cost of dredging a channel* 250 *feet wide to a depth of* 12 *feet.*

For dredging 60,000 cubic yards outside the point to sink the cribs and open a channel 12 feet deep, at 50 cents	$30,000 00
For dredging 59,842 cubic yards inside the river to deepen the channel, at 30 cents per cubic yard	17,962 60
Total cost of dredging	47,962 60
To build 2 cribs, 32′ × 25′ × 20′, as per estimates A	6,430 94
To build 84 cribs, 32′ × 20′ × 17′, as per estimates B	191,622 48
To build 655 feet of close piling, as per estimates C	6,555 56
Total cost	252,571 58

Respectfully submitted:

WM. T. CASGRAIN,
Assistant and Superintendent of Surveys.

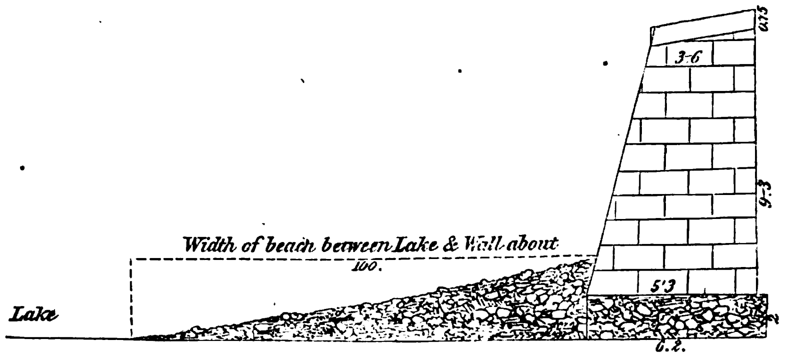
APPENDIX B.

Annual report upon the several civil works under the charge of Brevet Major General T. J. Cram, colonel of engineers, for the fiscal year commencing 1*st July,* 1866, *and ending* 30*th June,* 1867.

1.—SEA-WALL AT BUFFALO HARBOR, NEW YORK.

1. This work was commenced several years since. I find a small specific appropriation of $349 made for it in 1863. It has by some means, but how derived I do not know, been extended from the south pier along the sandy shore southeasterly for a distance of 5,400 feet; (sketch A.) The design seems to have been to make this construction along nearly parallel to and coextensive with the city ship canal for a total length of 7,050 feet, or about 1⅓ mile. 4,081 feet is built with a coping, 1,319 is built without the coping, and foundation is laid without anything above it for 321 feet more, leaving about 1,020 feet of the original design upon which nothing has been done. The part of the wall which has been erected under the late Major Tardy's charge is much better constructed than any of the previous work. The cross section of the wall is here shown. The foundation rests upon clay, underlying the sand; the clay is met nearly at the level of the lake water; the foundation is of concrete,

made of cement and beach gravel; the wall is laid upon it with rough rubble stone in cement.



The coping is of flat stone, hardly as wide as the top of the wall; the land edge of the coping is bolstered up on "spalls," giving the top of the coping an incline towards the lake. In those parts which were built in the first year of the construction, the mortar is seen to be yielding to the influence of the climate. In 1864 there was a specific appropriation of $37,500, and in 1866 another of $31,000, for this work.

2. Under the appropriation of 1864, the late Major Tardy commenced operations upon the sea-wall in October, 1864, and from that time until June 30, 1866, expended $35,554 55.

3. The operations under that officer, for the fiscal year commencing July 1, 1866, were as follows: Length of wall laid without coping, 160 running feet; laid in wall above foundation, 245 cubic yards; laid concrete in foundation upon which no wall was built, 221 cubic yards. Total expenditure in this fiscal year for wall and foundation, $9,194 06; made up of materials purchased, $1,035 87; labor, superintendent and foreman included, $6,345 12; contingencies, $1,813 07.

Hence, up to the termination of this fiscal year there has been expended a total of $44,748 61. This, deducted from the sum of the appropriations of 1864 and 1866, leaves the available amount to carry on the work for the fiscal year commencing July 1, 1867, $23,751 39. It seems that the late Major Tardy carried on the work not by contract; but as the law of 1866 required all to be done by contract that can be so done, it strikes me that the balance of the available means for this work should be done by contract, under the immediate supervision of a competent inspector.

4. Amount over and above the amount on hand required to be appropriated to complete the work to the extent of the original design, according to the rate of cost of the wall for the last fiscal year, $46,920.

I have not thought it advisable to recommend operations on this wall the present season, as there are other works of much more practical necessity to make preparation for at Buffalo. In fact, I see no particular necessity of extending this wall any further than it now is. It would be well, however, to complete the parts up to the present extent of the foundation which has been laid.

2.—HARBOR AT BUFFALO, N. Y.

This work was placed under my charge by orders from engineer department, March 28 last. After carefully examining this highly important harbor I submitted a special report upon the plan which I thought should be adopted, to adapt it not only to the present wants of commerce especially belonging to Buffalo, but likewise to the future enlarged demand of the lake commerce for vessels intending to discharge at this port or seeking refuge there during heavy blows so prevalent at that end of the lake. (See sketch B.) The plan proposed consists of the following items:

1. Repair and protect the existing south and north piers.
2. Extend the south pier three hundred to six hundred feet on the line of its present direction.
3. Endeavor to obtain the consent of the legislature of New York, during next winter session, for the United States to remove two hundred or four hundred feet of the south end of Erie Basin breakwater.
4. Construct a breakwater, B^2, which should be about four thousand feet long and eight feet high above water. This would stand in twenty-five feet water to cover the harbor from the prevailing winds and secure a large space between it and the shore for refuge.
5. To make examinations and a report in full for opening a ship channel from the lake, at what is denominated "South cut," directly to the Buffalo creek. The reply to this plan from the engineer department, dated July 9, was as follows: The department inclines to the approval of the project submitted in your report of the 20th ultimo, and directed operations for the present season to be confined to items 1, 2 and 3, in accordance with my plan, and to preparing detailed plans and estimates for the remaining improvements proposed by me.
6. Anticipating the approval of this or some other plan, I found it necessary to order my assistant, Captain F. Harwood, brevet lieutenant colonel, to make numerous measurements and examinations in order to obtain the condition of the parts of the piers requiring repairs, many lines of sounding in order to obtain an exact practical idea of the shape of the bottom, also many borings in the bed of the lake to ascertain the nature of the ground upon which the works are to rest. All these data it was necessary to obtain in order to intelligently draw the detail plans of the kind of construction, and before knowing what was to be advertised for proposals for furnishing materials and doing the work.

These examinations have more than occupied the party up to the expiration of the fiscal year to which this report belongs. I have no doubt, however, that they will be completed in season to enable me to perfect the plans, which it will take time to do, and put much of the work under contract the present season, so that materials can be accumulated and the work vigorously commenced by the spring of 1868. It takes a long time to collect sufficient materials for such an extensive work.

The amount of the available funds for this work at the close of the fiscal year was $200,000, nothing having been expended of this up to that time.

3.—DUNKIRK HARBOR, NEW YORK.

This was also placed under my charge 28th March last. After a careful examination of it, aided by my assistant, Brevet Lieutenant Colonel F. Harwood, and I had obtained the requisite data, I submitted a special report upon the plan which I thought should be adopted, June 20, 1867, (see sketch C,) and which was—1st. To commence and rebuild upon the old under-water work, which remains as a foundation, the west pier P, and extend the work quite to the beacon light 2d. Afterwards, when we get appropriation sufficient for the whole work, to commence the breakwater B and complete it. Both to be built of timber cribs and timber superstructure filled with rubble stone and planked over, instead of a superstructure of concrete masonry. These views were approved by the engineer department in its reply June 22, 1867, with the exception that it preferred 20 to 18 feet for width of the breakwater. I shall give to it a thickness of 20 feet. The working plans and bills of materials in detail were made for P, and the materials and labor for classes for each were advertised for proposals. The proposal came in and the contracts have been made.

The cost of P, as per the contract, augmented by 10 per cent. thereon for contingencies, will be	$37,439 00
The cost of constructing the breakwater B, according to prices in contract for P, including 10 per cent. for contingencies, will be	111,145 00
Total cost of P and B	148,584 00
The amount available of the appropriation for this at expiration of the fiscal year in question	100,000 00
Required yet more to be appropriated to complete the plan	48,584 00

Owing to the long time necessary after a contract is made to accumulate sufficient quantity of materials, not more than 300 feet of P can be put in this season.

4.—ERIE HARBOR, PENNSYLVANIA—(Sketch D.)

At the close of the fiscal year, June 30, 1866, there had been expended out of the $15,000 allotted to this work from the general appropriation of 1864, not requiring advertising for proposals for material and labor, in repairs of the old north and south piers only, $5,854 36. Up to that time this was all that was needed to be done in repairs of the old work, exclusive of the east breakwater.

In my inspection in the fore part of June last, I found that, since those repairs were made, several other holes and breaches had occurred in the under-water old timber work, and the stones fallen out into the harbor, caused by the old wooden pins, with which the timbers were bolted, being cut off by the action of the sand as if they were sawed, and by bad framing otherwise. To make the repairs required to stop, effectually, these holes, and to replace all decayed timber in both of the old piers, will require about $10,000.

Again, see on the sketch the line of old breakwater, constructed under the direction of Major Maurice, corps of engineers, many years ago, extending from south pier to shore. I have had this thoroughly examined during this last fiscal year, and we find that there is a portion, commencing at the pier and going towards the shore, of 705 running feet, in which all the crib-work seems to have been swept away, except some of the piles. The average depth of water along this is about four feet, and if this part be rebuilt, it should be raised to a height of four timbers above water, filled with stones, and planked over, and should be twelve feet wide, which, at $20 71 per running foot of piering, including ten per cent. for contingencies, would cost	$13,408 00
The remaining part of this breakwater, (779 running feet,) as we go towards the shore, shows a width of eight feet, and placing the old timbers in place upon which we could build a new work eight feet wide and three timbers above water, and drift-bolt the new down to the old under-water timbers, fill with stones, and plank over. This repair would average five timbers in height, two below and three above water, which, at $12 62 per running foot of piering, including ten per cent. for contingencies, would cost	9,831 00
It would also require a brush, stone, and timber construction to close the space between the inner extremity of this breakwater and the shore, which would cost about	500 00
Total cost of re-establishing the old breakwater	$22,739 00

In regard to the old line of west breakwater seen on the sketch, the sand has filled in so much between it and the lake that there is no necessity of rebuilding that work.

We thus have an estimate for the thorough repair and completion of all the harbor works to the amount of $33,739. This will have to be appropriated to accomplish all these repairs. The plan decided upon for the improvement of this harbor, under the appropriations of 1866 and 1867, was to extend the north pier 500 feet out into thirteen feet depth of water below lowest stage, and to dredge out the whole space between the piers called the outer bar, so as to allow a uniform depth over that space of twelve feet below lowest known stage. The amount of these two appropriations was $61,961, and required to be expended under contract to the lowest responsible bidder. Considerable time was necessarily consumed for making the contracts before we could begin the actual work at the harbor. On about the 20th March, 1867, the contracts were made, and from that time to June 30, 1867, there was expended $6,214 91. The cost of extending the north pier, including ten per cent. for contingencies, will be $34,339. Hence there will be left available out of those appropriations, for dredging and other purposes, $27,622.

This is one of the harbors which I reported February 1, 1867, as being worthy of improving to a condition of allowing vessels of fourteen feet draught at all times to enter and depart, and I now give the estimate of the additional appropriation required to be made to all former appropriations for attaining this object, including ten per cent. for contingencies, $35,000.

Dredging outer bar—This was begun on the 16th day of April, 1867, and during the remainder of that month 1,878 cubic yards were raised and dumped. From that time to 30th June, 1867, (end of fiscal year,) no more was done, because of the stipulation in the contract that no dredging of the outer bar should be done in advance of the progress of the extension of the north pier. The dredging will be resumed and carried on in accordance with this stipulation.

5.—CONNEAUT HARBOR, OHIO—(Sketch E.)

The appropriations of 1866 and 1867 for this amounted to $30,513, both requiring to be done under contracts which were made October 1, 1866; and during the fiscal year in consideration there was expended to June 30, 1867, $3,134 81; leaving July 1, 1867, available, $27,378 19. The plan fixed upon for the improvement was to thoroughly repair the old piers, and extend the west pier into twelve feet water, and dredge the interior between the piers and outer bar to obtain twelve feet water throughout at low stage. The cost, according to the contract of the thorough repairs of the old piers, including the building up of the breached flaring 130 feet of east pier on a straight course for the same extent out into the lake, will be $9,064, including 10 per cent. for contingencies.

I advertised May 17, for proposals for dredging A very high single bid was received at $1 25 per yard, owing to doubts entertained upon the character of the earth to be dredged, and the bottom upon which the extension of the west pier for 350 feet is to be built. I had, after I inspected the work, 1st June last, borings made into the bottom. The auger penetrated to rocks, showing a regular dip to the northward of 7.7 feet in 360 feet, or a dip of one-fourth of an inch vertical to one foot horizontal. But in no place did we strike rock until we had descended more than twelve feet below low-water stage. Sand is the material to be dredged, and at the proposal I received, ($1 25 per yard,) the total dredging contemplated in outer bar would cost, including 10 per cent. for contingencies, $10,265.

I considered that bid, based upon a different view entertained by the bidder from my own concerning the character of the bottom, unreasonably high. I have therefore not made a contract for the dredging, but concluded postponing the matter, and advertising again for dredging, at the same time of advertising for the materials and work for the extension of the west pier to be done next season to the extent proposed, should Congress make the necessary appropriations. The cost of the dredging to place the cribs, and for the bar and interior, ought not to exceed $6,181; the cost of the extension of the pier, $22,771, including 10 per cent. for contingencies. We therefore find that in addition to the appropriations of 1866 and 1867, we shall need an appropriation to complete the work to the extent and capacity planned for, of $10,638.

6.—ASHTABULA HARBOR, OHIO—(Sketch F.)

The two appropriations for this in 1866 and 1867 amounted to the sum of $78,708 32. The plan adopted for this was to—1. Thoroughly repair both of the old piers. 2. And to extend them to twelve feet water into the lake in parallel lines, doing away with the flare. 3. To dredge between old piers and the extension so as to obtain twelve feet water throughout below lowest stage.

Contracts were made for materials and labor for item 1, about the 1st October, 1866, and thorough repairs of the old piers upon the estimate of materials and labor for the work first made will cost, including 10 per cent. for contingencies, $11,838; and at the close of the fiscal year ending 30th June, 1867, there had been expended $5,944 03, leaving 1st July, 1867, a balance on hand of $72,764 29.

From the survey made by W. T. Casgrain, under the direction of the superintendent lake survey, in May, 1865, upon which plans and estimates for the improvement, items 2 and 3, were based, we inferred that we should have to dredge in shale rock between the piers, also on the outer bar, in order to obtain twelve feet water below low stage. Much time was spent in studying plans and estimating for such a condition of the bottom, and it was upon that condition that I made my estimate upon which Congress appropriated in 1867, and that item 3 was advertised for proposals May 17, 1867. The lowest (and there was only one) bid was for the sand $1, and for shale $2 75, if no blasting was required; but if blasting was required, $4 50 per yard. These conditions vitiated the bid, and in my inspection in the fore part of June, coming to the opinion that there was no evidence of rock exterior to the old piers that would require dredging, I ordered borings to be made to test the question. These borings show that we shall not come to rock, but be in sand for the whole depth of twelve feet below low stage, from A in the sketch for 450 feet out to the twelve feet depth of water in the lake.

But from the point A, as we go interior for 565 feet we come to rock that will have to be dredged to obtain twelve feet water for the harbor between the old piers. This rock is overlaid with sand and gravel.

Now I dare not dredge the interior harbor close up to the piers to twelve feet depth for fear of undermining these old structures. I think they were mostly laid upon the sand without dredging to pose them upon the rock. But I think we can safely make a channel sixty feet wide in the middle of the water-way to the required depth without undermining, and as the new extensions are to be laid on a level bottom, twelve feet water, we can dredge the whole space between them on the outer bar to the required depth. The interior dredging to sixty feet width will be sand, 2,763 cubic yards; gravel, 627 cubic yards, and rock 3,892 cubic yards. The exterior dredging, including dredging to lay the piers, will be sand, 5,880 cubic yards. Since the examination I instituted was made, in June last, entire new plans and estimates have had to be made differing considerably from those made upon Mr. Casgrain's survey. I estimated upon the new survey the proposed extension of both piers to cost, including 10 per cent. for contingencies, $38,526; and the dredging inside of the piers, and to place the cribs and to remove the outer bar, including 10 per cent. for contingencies, $18,851:

hence after repairing old work, item 1, extending the piers by new work, item 2, and dredging, item 3, we shall probably have left about $3,569, requiring no further appropriation to be made for this work.

7.—GRAND RIVER HARBOR, OHIO—(Sketch G.)

This harbor was commenced to be repaired, under the appropriation of 1864, upon the allotment of $10,000 at first; afterwards increased to $24,453 24, out of the general appropriation for repairs and preservation of lake harbors, works not requiring to be done by the lowest bidder after advertising for materials and labor.

There was a difference of opinion as to the manner and plan of repairing this work. I recommended that as the old flaring part of the west pier from "X" out to "Y" was breached and much of it gone, it would be best to repair that pier out to "X," and thence carry a work straight out parallel with the old east pier for an equal extent of the flare. I was overruled in this and ordered to repair the whole quite out to "Y," and to repair the whole of the east pier which was done, costing $24,453 24; all this out of the appropriation of 1864. Of this amount there was expended in the fore part of the fiscal year commencing July 1, 1866, $8,443 60, and the completion of the repairs of the old pier to their outer extremities has been accomplished.

Believing that we could remedy the evil of the flare by extending out the east pier by a new construction in a parallel direction with "X Y," I made plans and estimates for doing so, and the sum asked for was appropriated 23d June, 1866, to the amount of $22,111 80.

I was also overruled in my recommendation as to the direction of extending the east pier, and required to make another survey, &c. which I made in the winter of 1867 on the ice. The result of this survey confirmed me in the opinion that the best plan was to extend the east pier from "E" to "E′" around parallel to "X Y" of the west pier.

The engineer department, however, took a different view upon the question and ordered me to extend from "E" straight out on the prolongation of the old direction of the east pier, and called for an additional appropriation of $60,000, which was made by act approved March 2, 1867, thus making available the appropriations of 1866 and 1867 for the extension of the east pier, and any other improvements that may be required for this work the sum of $84,453 24.

The work of extension was put under contracts, materials and labor, about 20th March, 1867. Since that time and up to the close of the fiscal year ending 30th June, 1867, there has been expended out of this ($84,453 24) the sum of $3,143 02, leaving available at the end of that fiscal year $81,310 22. The cost of extending the east pier three hundred and twenty feet will be, according to the contract, including 10 per cent. for contingencies, $21, 631; and after this is done we shall have the probable available sum for future improvements of this harbor, (in dredging probably,) $33,040 30, requiring no further appropriation at present.

8.—CLEVELAND HARBOR, OHIO—(Sketch H.)

The sum allotted from the appropriation of 1864 for the repairs of this work was $20,000. A less sum than this from that appropriation, however, has been applied to its repairs, being only $12,310 79. Of this during the fiscal year commencing July 1, 1866, and ending June 30, 1867, there was expended $1,949 27.

Inasmuch as the principal part of the east pier had been monopolized by a railroad company, it was decided by orders from the engineer department that no repairs should be done to the east pier at the expense of the United States.

In my former reports I have fully set forth the uses and abuses of this pier, all of which still continues, and in consequence the old pier is fast going to destruction. The plan for enlarging this harbor was settled upon, consisting in an extension of both piers out into the lake as shown in the sketch in red; and for this purpose an appropriation was made by act approved 23d June, 1866, of $59,806.

The contracts for the extension were made about the 10th of October, 1866, for materials and labor, and for the execution of the work. During the fiscal year ending June 30, 1867, there has been expended out of the appropriation, principally for materials, $8,215 55. Making an expenditure out of this and of the appropriation of 1864, during the fiscal year commencing July 1, 1866, and ending June 30, 1867, of $10,164 82. The amount available July 1, 1867, from the appropriation of 1866, was, therefore, $51,590 45. The cost of the extension of the piers, according to the plan and upon the contracts made will be, including ten per cent. for contingencies, $63,497. Required, therefore, to complete the present plan, an additional appropriation of $3,691.

This is one of the harbors recommended in my report of February 1, 1867, as entitled to the consideration of being improved to the condition of allowing vessels of fourteen feet draught to enter and depart at all times. Should this enlargement of capacity, which is highly desirable, be ordered, there will be required for this purpose another additional appropriation of $38,622.

9.—BLACK RIVER HARBOR, OHIO—(Sketch I.)

During the fiscal year commencing 1st July, 1866, and ending 30th June, 1867, there was expended in the completion of the repairs of both of the old piers, thoroughly, to their outer extremities, the sum of $10,334 88. This was all from the appropriation of 1864. In a year or two hence there will probably be required an expenditure for stopping holes that may develop themselves in the old under-water work of west pier of some few thousands of dollars. The rebuilding of the outer extremity of the east pier has much improved the depth over the outer bar and restored the harbor to a condition of usefulness. The appropriation made in 1866 of $10,000 for this work is still available for the future repairs above alluded to.

10.—HURON HARBOR, OHIO—(Sketch J.)

By act approved June 23, 1866, there was appropriated for this work the sum of $39,000. The plan decided upon was to thoroughly repair both piers, including building up the cribs that had been swept away from the extremity of the east pier. After duly advertising, contracts were entered into for materials and work for this purpose about the 3d of October, 1866; the timber was all to have been delivered by the 10th of June, 1867. The contractor failed to furnish all, and the difficulty was made good by advertising anew, and a contract was made for it with the lowest responsible bidder on the 22d of June, 1867. The percentage already retained from the first contractor was more than sufficient to make good all loss to the work by this failure. The amount expended out of the above appropriation during the fiscal year commencing the 1st of July, 1866, and ending the 30th of June, 1867, was $10,960 24, leaving on the 1st of July, 1867, available, $28,039 76. The cost of the repairs according to the contracts, including ten per cent. for contingencies, will be about $25,070 15, which is less than the appropriation by $13,929 85. No additional appropriation will therefore be required for this work.

11.—VERMILLION HARBOR, OHIO—(Sketch K.)

The amount appropriated for the repairs of this harbor by act approved June 23, 1866, was $15,315 74. The piers were much dilapidated, and seven cribs of the lake extremity of the east pier have been breached away. The plan was, to rebuild these cribs for their whole width, and for the superstructure that was to be rebuilt, to make it 12 feet wide above water, and ballast by filling with stone and planking over. Contracts for the material and labor were made on the 10th and 20th of October, 1866. The amount expended to June 30, 1867, was $11,987 16, leaving on hand July 1, 1867, only $3,328 58. The total cost of thoroughly repairing the piers, including ten per cent. for contingencies, will be $21,827, costing considerably more than was estimated previously to the appropriation being made. More work, however, will have to be done before exhausting the appropriation than was originally estimated for.

The first examination was made as well as it could be under the circumstances, but other damages have been found, by a more critical examination, in the old under-water west pier; and, since stopping a 400 feet breach in west pier, a cutting away of the shore at the inner extremity has occurred, requiring much work to secure the pier there against destruction, an additional sum, either by special appropriation or out of the general fund for "repairs and preservations," to the amount of $6,511. With this I think we can have, before the expiration of the present summer, the work fully repaired. But if this is put off to another season it will probably cost much more, owing to the breaches that will occur during the coming winter.

12.—SANDUSKY CITY HARBOR, OHIO—(Sketch L.)

For this there was appropriated by act of June 23, 1866, the sum of $38,580 The plan decided upon was not at first to construct the side piers P P seen on the sketch, but to dredge a channel 400 feet wide across the narrow outer bar to a depth of 12 feet below the lowest known stage, and wait for the effects upon it, and afterwards to decide whether the piers would be necessary. Accordingly, after duly advertising for proposals, a contract was made for the dredging on the 12th day of October, 1866, to commence with one dredge as soon as the weather would permit. The weather, however, did not allow of dredging in that exposed place before the expiration of the fiscal year, June 30, 1867. The amount expended to June 30, 1867, was only $2 10, leaving, July 1, 1867, available, $38,577 90, and no additional appropriation needs to be made for this until after the effects following the dredging may show the necessity of further appropriations.

13.—SURVEY AND IMPROVEMENT OF SANDUSKY RIVER, OHIO.

(See map of this river, engineer department.)

By act approved June 23, 1866, an order was made for a survey of Sandusky river, with a view of plans and estimates for its improvement. In October, 1866, I had the survey commenced, and completed in December following, costing in all (for the survey) $468 90. This was defrayed out of the appropriation for "examinations and survey on the northwestern lakes." The maps of the survey were forwarded to the engineer department, with a report containing an estimate for improving by dredging between the town of Frémont, Ohio, and the Sandusky bay, December 4, 1866. The total amount of dredging estimated for the improvement of the river in seven different places was 185,075 cubic yards sandy earth to be excavated, so as to give a 12 feet channel from 160 to 200 feet wide at the various places. By act approved March 2, 1867, the sum appropriated for the improvement was $20,000. In May following advertisements were issued for proposals to do the work. A favorable contract was made for it, as far as we have or shall obtain the means, June 5, 1867. The amount expended on the improvements to June 30, 1867, was $7 60, leaving amount available July 1, 1867, $19,992 40. At the prices in the contract the improvement of all the places will cost, including ten per cent. for contingencies, $54,967. Hence to complete the work upon this plan for the improvement we should require an additional appropriation of $34,967.

14.—TOLEDO HARBOR, OHIO—(Sketch M)

By acts of June 23 and March 2, 1867, the sums appropriated for this improvement amounted to $40,000. The plan decided upon for this improvement was to dredge the channel to a width of 200 feet and to a depth of 12 feet below the lowest stage from buoy No. 1 to buoy No 7 seen on the sketch, an extent of 4,800 feet. Advertisement was published inviting proposals August 15, and a contract was made October 12, 1866, to commence the dredging and continue it during that fall, weather permitting. But the weather did not allow dredging to be done so late in that season. In the winter, taking advantage of the ice, range signals were erected so as to guide the dredge in its work. The dredging commenced the 27th of March, 1867, and up to the end of the fiscal year (June 30, 1867) 16,236 cubic yards were raised by one dredge, tugged away, and dumped. The actual number of working hours of the dredge was 425. The number of days on which the dredge was prevented by bad weather from working full work (ten hours) was 47, and by the breaking of the machinery, was 16. Amount expended on the work during the fiscal year ending June 30, 1867, $4,564 62, leaving available July 1, 1867, $35,435 38.

I do not think it advisable to ask at present for an additional appropriation to be expended in this particular direction, from the mouth of the river making such a short turn.

For so important a commercial place as Toledo is, and for its future growth of commerce, the improvement should be one commensurate with the commerce of the place, and should be made upon a scale and direction adapting it for refuge for vessels passing up and down the lake in all weather.

This is one of the harbors I recommended in my report of 1st February, 1867, as worthy of being made so a vessel drawing fourteen feet could enter and depart at all times, and estimated that it would cost $469,664. This contemplated a channel 300 feet wide. The plan, however, for making this one of the very best improvements would be to prolong the river straight from A out to the fifteen-feet water in the lake, in the direction of the red-arrow line seen on the sketch, and dredge a channel 200 feet wide. which would be about four miles long, and to a depth of fifteen feet, using the materials to make the canal banks, that should rise five feet above water and dike the sides. But to obtain a close estimate of the cost of such a work, it would require a previous examination and survey, with borings along the line. From my personal knowledge of the Maumee river, for the canal and adjacent ground, every inch of which I have been over, I am satisfied the material to be dredged would be highly favorable for such a work, and, what is quite as important, that the force of the out-flow of the Maumee river would ever keep the canal free from deposits. I do not think a better application of a few hundred dollars of the appropriation for "examinations and survey of the northwestern lakes" could be made than to apply it to the examination for the improvement, herein suggested, through the Maumee bay.

By order of the chief engineer, in 1863 and 1864 I made complete surveys and a detailed report, and selected sites for the temporary works for military defences of the harbor. These surveys show that the defence of the bay is easy, and may be made very perfect.

15.—MONROE HARBOR, MICHIGAN—(Sketch N.)

By act approved 23d June, 1866, there was appropriated for this work $31,015 27. The plan adopted for its repairs was, 1st, to rebuild the outer breach part of south pier, and to repair the decayed and broken portion of the inner parts of that pier; 2d, to repair the west pier thoroughly; 3d, to construct a new work of 300 feet in length to connect the inner part of the west pier with shore, to stop a dangerous breach that had been opened here in the side of the canal, allowing sand to be driven through from the lake beach into the harbor at every blow from the northeast.

It required much labor in making measurements and plans and bills of materials to fit everything to the old work. Borings were made to determine how to place the construction of the new work, (item 3.) After duly advertising, inviting proposals, contracts were made 2d October, 1866, for the material and for doing the work. The delivery of materials and doing the work were pushed through the winter, and the energetic contractor, W. H. Mott, taking advantage of the favorable condition of the ice which covered the harbor, all the exterior under-water work of item 1 was securely put in before the spring thaw came.

Up to the end (30th June, 1867) of the fiscal year there had been expended $6,760 06, leaving available 1st July, 1867, $24,255 21. By the price in the contracts, the cost of completing all the items, 1, 2, 3, including ten per cent. for contingencies, is $12,484 36, leaving, after completing items 1, 2, 3, $12,770 65, which can be applied to the harbor hereafter, as circumstances may develop. No additional appropriation seems necessary to be asked for at present for this work.

16.—ST. CLAIR FLATS, MICHIGAN—(Sketch O.)

By act of 23d June, 1866, and of 2d March, 1867, there were sums appropriated for this improvement amounting to $230,000; and by the last of said acts Congress fixed the plan to be followed for the improvement, to consist of a straight, direct ship canal from sufficiently deep water at the mouth of the south pass of the St. Clair river, through the shoal, to sufficiently deep water in Lake St. Clair, an extent of about one and a half mile; the canal to be 300 feet wide in the clear—sides to be diked and banked, to be made five feet above water and fifty-eight feet wide on top, of the materials to be dredged out to make the water-way thirteen feet deep below lowest known stage.

After receiving orders to make preparations for commencing the work, advertisements were published inviting proposals for furnishing materials and doing the work, March 20, 1867. Owing, however, to my absence under orders from the War Department, the bids were not opened and the abstracts of them made out, so as to decide who were the lowest responsible bidders for materials and labor, until May 7, 1867. A difficulty arose in awarding the contracts, and this was not allayed before the expiration of the fiscal year, 30th June, 1867, so that up to that date nothing had been accomplished, but much office work.

Amount expended to 30th June, 1867, $29 68, leaving available 1st July, 1867, $229,970 32. My first approximate of the cost of the work was $428,754. As yet I know of no reason why this estimate should be enlarged, though, when we come to exactly locate the work and take the soundings referred to, the lowest known stage, we may find a result differing somewhat, in the amount of dredging, from what I estimated and based upon the survey of 1856, made under the direction of Captain, now Major General, Meade. It was upon that survey, the last we have, that I made my estimate, and so stated in my first report, August 13, 1866, and in my revised report, December 10, 1866. Upon that basis, therefore, besides what was available July 1, 1867, we shall need an additional appropriation to be made by Congress for the completion of this work to the amount of $198,754.

Notwithstanding the embarrassment arising to prevent putting this improvement in operation during the past fiscal year, I have no doubt that we shall commence active operations on the work by at least two dredges before the close of September, 1867, and be able to push it to an entire cempletion, as Congress will make the needful appropriations.

17.—SAGINAW RIVER MOUTH—(Sketch P.)

By acts 23d June, 1866, and 2d March, 1867, the sums appropriated to this highly important work amounted to $95,500.

This estimate, it is to be borne in mind, is based upon a survey made under the direction of Captain Macomb, topographical engineer, in 1856, without representing the character of the bottom to be dredged. Advertisement was published inviting proposals for executing this work August 28, 1866. A favorable contract was made 5th Octobe 1866. Owing, however, to the lateness of the season, work could not be commenced that season, and the time for completing the work to the 30th November, 1868, should the materials to be dredged prove hard. The plan fixed upon was to dredge a channel from the lower reach of the river proper, straight out into the lake, whatever materials might be found in the way, for a width of channel at bottom at first of 195 feet, with side slopes of two horizontal to one vertical, and to a uniform depth of twelve feet water below the lowest known stage of water, and to make it 200 feet wide afterwards, as we could obtain the means. Taking advantage of the ice during the winter, I had made under my direction a complete set of soundings and borings into the bottom to the required depth for dredging. These borings developed a remarkable formation of earth.

I also had during the winter the channel to be dredged perfectly located, and ranges on the mainland crected by which the dredges should be guided in making the channel to the proper width and alignment and the "bench mark" established for the lowest stage of water, by which the depth of dredging should be regulated, and the place marked for dumping. The operation of dredging commenced 21st May, and on that day a furious northeast gale suddenly arose and drove the large dredge ashore; owing to this bad luck to the contractor and the bad weather it was not until the 12th June that he could recommence. During the remaining sixteen working days of that month there were dredged and dumped 3,426 cubic yards of very hard conglomerate clay, gravel, and sand. This closes the operation up to the end of the fiscal year, 30th June, 1867. I am gratified to find that notwithstanding the hardness of the material, there is no doubt of our being able the present season to open a channel before its close of navigation, that will admit vessels of ten feet draught, running through the entire length of the new cut. The portion which will be dredged will be to the full depth of twelve feet, the work having been commenced on the summit of the bar and extended both ways. One of the most powerful machines, and the best adapted in the United States, is working admirably in this hard material, sweeping the whole width, 195 feet, of the channel and to the full depth at a swing, leaving the bottom as even as a house floor. Two dredges are at work and each performing admirably, giving assurance of a complete success in the undertaking of the opening of a channel which before we commenced had to many the appearance of a quixotic effort, but which now begins to challenge admiration.

The amount expended to the 30th June, 1867, was $422 32. The portion dredged not having been paid for until July, comes into the next fiscal year's expenditure.

Amount available 1st July, 1867, was $95,077 68.

As yet, I have no evidence of its costing more than I estimated in my last annual report to complete this work. I do not therefore ask at present any additional appropriation for this work.

18.—HARBOR AT AUSABLE RIVER, MICHIGAN—LAKE HURON—(Sketch Q)

After this was placed under my charge I found it necessary to make a tedious special study of the question. The survey that was made for this work by the lake survey assistant was defective in two essential points. No reference was given by which the low stage of water at the mouth of the river could be compared with the stage at the time of the survey, nor was there a bench mark made to which the stage, even at the time of the survey, can ever be identified. These are points too much neglected by officers and assistants of our corps, who are intrusted with these important surveys, and the officer who is called upon to make the detail plans and drawings, and bills of materials and the estimate of the cost of the work, is forced to grope in the dark for the proper data to work upon.

I planned a work, however, for a ten-foot harbor, the stage of reference to be fixed hereafter, and it was approved, and advertised inviting proposals May 14, 1867, and reported an abstract of the bids received June 11, 1867. Owing to contention among the bidders arising from a difference of opinion as to what should be the construction of the law in reference to the principle of awarding contracts, this work has not been put under contract up to 30th of June, 1867. I have no expectation that it is possible to obtain a sufficient quantity of materials to judiciously commence work with until the 30th of May, 1868. From that time forward the work may be expected to be as rapidly pushed forward as the very unfavorable circumstances attending the place will permit.

By act approved 2d of March, an appropriation was made for this work of $50,000, and all of this was available 1st of July, 1867.

I have been able to make a close estimate of the cost of completing the work upon the plan fixed upon and the bids from responsible contractors for furnishing materials and doing the work, but not so close as I could have done had the faults in the survey not been perpetrated. The estimate of the cost, including ten per cent. for contingencies, is $69,367. We shall, therefore, need an additional appropriation to complete the work of $19,367. This, put with the $50,000 already available, will give us as good a harbor at this site as the case admits, but which, however well we may first construct it, will need in a few years much dredging from the enormous quantities of sand which the river brings along from the interior into the lake to be deposited at the mouth.

19. IMPROVEMENT OF ST. MARY'S RIVER, MICHIGAN—(Sketch R.)

By acts of 23d of June, 1866, and 2d of March, 1867, the sums appropriated for this work amounted to $100,000.

After fixing upon the plans for expending the money to the best advantage for the large and increasing commerce that is to be benefited by the improvement of this river, proposals were invited for dredging, August 23, 1866, and a favorable contract was made for dredging, (only at present, however, in middle channel Lake George, a shoal expansion of the river,) 5th of October, 1866. The work was to be commenced as soon as machines could be taken there and completed, either by November, 1867, or in the following season of 1868, according to the softness or hardness of material found necessary to excavate to obtain a channel not less than 200 feet wide at bottom, and of a uniform depth of fourteen feet below low stage at middle channel, and thirteen feet depth at sides, with side slopes of two horizontal to one vertical. It was not possible, owing to the lateness of the season, before the contract was concluded and approved, to get the dredges safely into position before the 22d of June, 1867. As soon as possible I sent my assistant, Captain Lydecker, corps of engineers, who fixed the range signals and established the low-water "bench-mark" to guide the dredges, and located the field for dumping. On the 29th of June dredging commenced in good earnest, and up to the 30th of June, 1867, there had been excavated eighty yards. From the 1st of July, 1867, onward there are to be two dredges at work day and night.*

Disbursed up to 30th of June, 1867, end of the fiscal year, on the work, $4 56, leaving available 1st of July, 1867, $99,995 44.

I have seen no reason since sending in my annual report for fiscal year ending 30th of June, 1866, to change the estimate I have made for the improvements of the several places requiring work to be done in this great river. Therefore there will yet remain to be appropriated to complete the improvements, including ten per cent. for contingencies, $323,983.

20. *Summary statement for the fiscal year commencing July* 1, 1866, *and ending June* 30, 1867.

Name of work repaired, improved, or surveyed for improving.	Amount expended under appropriation of 1864.	Amount expended under appropriations of 1866 and 1867.	Amount of full estimate for completion required to be appropriated.	Amount that can be profitably expended in next fiscal year commencing July 1, 1867, and ending June 30, 1868.
Sea wall, Buffalo	$35,554 35	$9,194 06	$46,920 00	$30,000 00
Buffalo harbor, New York				15,000 00
Dunkirk harbor, New York			48,584 00	50,000 00
Erie harbor, Pennsylvania	5,854 36	6,214 91	33,739 00	50,000 00
Conneaut harbor, Ohio		3,134 81	10,638 00	38,000 00
Ashtabula harbor, Ohio		5,944 03		70,000 00
Grand River harbor, Ohio	8,443 60	3,143 02		22,000 00
Cleveland harbor, Ohio	1,949 27	8 215 55	3,691 00	63,497 00
Black River harbor, Ohio	10,334 88			
Huron harbor, Ohio		10,960 24		25,000 00
Vermillion harbor, Ohio		11,987 16	6,511 00	9,839 84
Sandusky City harbor, Ohio		2 10		30,000 00
Sandusky river survey and improvement		*476 50	34,967 00	19,992 40
Toledo harbor, Ohio		4,564 62		35,435 38
Monroe harbor, Michigan		6,760 06		5,724 00
St. Clair flats, Michigan		29 68	198 754 00	250,000 00
Saginaw river, Michigan		422 32		65,000 00
Ausable harbor, Michigan			19,367 00	50,000 00
St. Mary's river, Michigan		4 56	323,983 00	60,000 00

* For survey, $168 90; for improvement, $7 60; out of appropriation "Surveys and examination northwestern lakes."

REMARKS.—This table does not contain the estimates for adapting Buffalo, Erie, Cleveland, and Toledo to vessels drawing fourteen feet of water; for these additional estimates see text to the report.

Of course it is understood that the foregoing report makes no record of work done or expenditures made since 30th of June, 1867. Since that time a large amount of materials have been delivered, and much work has been done on all the works that were put under contract before the expiration of the last fiscal year, all of which, with the expenditure, will come properly in place in my next annual report.

I have the honor to be, very respectfully, your most obedient servant,

T. J. CRAM,
Colonel Engineers, Brevet Major General.

Major General A. A. HUMPHREYS,
Chief of Engineers United States Army.

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* In July one dredge working twenty-one days, and two three days, relieving each other at night, raised 15.287 cubic yards soft. In August two dredges, relieving each other at night, raised 32.561 cubic yards soft. Number of hours worked, 1,169¼; which means that this is tantamount to one dredge working 1,169¼ hours to raise 47,848 cubic yards soft material of that channel bed.—*September* 12, 1867.

B 1.

UNITED STATES ENGINEER OFFICE,
Detroit, June 11, 1867.

SIR: I have the honor to make this report upon the contemplated harbor at Ausable, Lake Huron:

I. In your order of 28th March last, assigning this work to my charge, I was directed to submit my views, in case of a dissent from Colonel Raynolds' plan, for this work. I do not dissent from the general plan as to direction, extent of piers, and width of channel-way; but I respectfully submit that a ten-feet depth of water for this harbor will cost about thirty thousand dollars less than to make a twelve-feet harbor, as proposed and estimated for by that officer. All acquainted with that place are of opinion that this will be ample for all the trade there. And owing to the enormous quantities of sand away up in the river, and the other causes for accumulating deposits at the mouth of the harbor when constructed with all the care possible, I am satisfied that to maintain even that depth (ten feet) we shall have to resort to dredging, or extend the piers indefinitely beyond the present proposed limits. A bar will form across the mouth in a few years after constructing the piers. The lowest bid for constructing the work for a twelve-feet harbor is $82,892 72; the lowest bid for constructing the work for a ten-feet harbor is $58,037 37. Which depth shall be adopted?

II. I have advertised and received proposals for each, as will be seen by the accompanying advertisement, and bids have been put in according to the advertisement, more especially according to the classifications (see last paragraph of advertisement) of work or labor and of materials, as shown on the abstract of bids herewith sent. To this classification, which is in harmony with the law making the appropriation, we must adhere, if we expect to hold the bidders up to the proposals, and successfully accomplish the work to good advantage.

For the materials: class 1, round piles; class 2, sawed timber and lumber; class 3, all kinds iron material.

For the labor or work: class A, dredging to place cribs, framing, boxing, bolting, placing, driving piles in their corners, superstructure, filling the cribs with stone, slabs, and brush, framing, fitting joist, plank, &c.; class B, dredging channel between piers and just above piers in the river.

For each class of materials the lowest bidders are Carkin & Kimball, No. 3. For class A, labor or work, the lowest bidder is H. M. Mixer, No. 5. For class B, labor or work, the lowest bidder is Hasbrouck & Conro, No. 4.

Observe: Henry M. Loud, No. 8, in his bid for the whole, set class 1 (round piles) lower than No. 3 did, but No. 8 bid for the whole or none. It will be seen by the abstract, for either a twelve or a ten-feet depth of harbor, the above-named are the lowest bidders.

I have to request the proper instructions from the proper authority to make the contracts with Nos. 3, 4, 5, as above named. I also request to be informed whether to contract for a twelve-feet or a ten-feet harbor.

Very respectfully, your obedient servant,

T. J. CRAM,
Colonel Engineers, Brevet Major General.

Major General A. A. HUMPHREYS,
Chief of Engineers United States Army.

P. S.—For a twelve-feet harbor we have proposals for constructing the same length of piering and planking it over, $31,861, less than estimated for by Colonel Raynolds. This is the result of a more economical plan for cribs, and using slabs and brush to some extent, and less stone than proposed in his estimate.

To Contractors.

OFFICE LAKE AND RIVER HARBOR IMPROVEMENTS,
Detroit, No. 111 *Griswold street.*

Written and sealed proposals for furnishing materials and doing the work will be received at this office, addressed to the undersigned, until the 31st of May, 1867, for constructing the piers and dredging for a harbor at the mouth of Aussable river, Lake Huron, Michigan.

Materials required.

CLASS 1.

240 round white oak piles, 12 inch middle diameter, 30 feet long.

CLASS 2.

1,560 side timbers, sawed, 12 by 12, 30 feet long.
120 side timbers, sawed, 12 by 12, 32 feet long.
360 side timbers, sawed, 12 by 12, 20 feet long.
2,656 cross timbers, sawed, 12 by 12, 16 feet long.
1,020 crib-bottom, sawed, 8 by 12, 16 feet long.
52 brace timbers, sawed, 8 by 8, 9 feet long.
210 scantling, sawed, 3 by 4, 14 feet long.
1,260 boards, sawed, 1 by 12, 20 feet long.
900 joists, sawed, 2 by 12, 9⅔ feet long.
1,661 covering plank, sawed, 2 by 12, 16 feet long.
The total amount of the sawed stuff, 1,436,920 feet, board measure.

CLASS 3

1,455 bars 1-inch square iron, 16 feet long, 77,115 pounds.
Wrought spikes, 6 inches long, 420 pounds.
Wrought spikes, 4 inches long, 2,057 pounds.
10d. cut nails, 120 pounds.

CLASS 4.

2,180 cords rubble stone, measured in cribs.
840 cords of slab.
840 cords of brush, measured under a pressure of 132 pounds to the top of the cord, after being put in the crib.

State the price per pile for class 1.

State the price per thousand feet, board measure, all sawed stuff, class 2.

State the price per pound for the iron, per pound for the spikes, per pound for the nails, class 3.

State the price per cord for stone, also for slabs, also for brush, class 4.

The government reserves the right of diminishing the above quantities should it be decided to make a ten instead of a twelve feet harbor.

The timber to be of white oak, white or Norway pine, all sawed truly and squarely to dimensions stated, from good live timber, and to be free from rotten knots, splits, shakes, and other defects tending to impair its durability or strength. One-fourth of the piles and timber to be delivered on or before the 1st day of July, 1867, and for four months in instalments of one-eighth monthly thereafter during navigation, and all of the remainder on or before the 30th April, 1868.

Work to be done under water.

There are 60 cribs 30 feet long, 14 or 16 feet wide, to be placed in 10 or 12 feet depth of water, on a sand bottom, where the average depth of water is now about six feet; the total length of both piers to be 1,800 feet; a pile is to be driven in each crib-corner, and the cribs to be filled with brush, slabs, and stones, in proportions to be given. The amount of dredging to place the cribs in 12 feet water is 4,433 cubic yards.

After constructing the two lines of piers, 45,121 cubic yards, to make a twelve feet harbor, is to be dredged out from between the piers and up the river immediately above the piers. The earth to be dredged as all sand. In the cribs there will be about 94,080 running feet of twelve inch square timber, and about 28,560 feet, board measure, of boards and scantling in the cribs. State the price in the bid for dredging per cubic yard to place the cribs. State the price in the bid for framing, fastening, boring, and bolting, and putting in place the cribs per running foot of timber so framed and put into the cribs. State the price per M feet, board measure, for fitting and fastening in scantling and bottom boards.

The above amounts of work to be done will be about one-sixth less should a 10 feet instead of a 12 feet harbor be made.

Work to be done in superstructure above water.

There will be 1,800 running feet of pier work, 14 or 16 feet wide, and four timbers high, above the tops of the cribs and surface of the water, and to be filled with stones and covered with plank spiked down to the joists, which are to be grained and spiked into the cross ties. State the price in the bid for framing and fastening the superstructure per running foot of timber, of which there will be about 22,684 running feet in the superstructure. State the price for joining and spiking in the joists and fitting and spiking on the covering plank per thousand feet, board measure, of which there will be about 70,552 feet board measure.

Bidders are cautioned to conform strictly with the manner above given in proposing their prices, both for the items in the classes of materials and for the items of work specified.

The time for completing all the work will be extended if required by the contractor until the fall of 1868.

It is highly desirable that the furnishing of all classes of materials and doing all the work should be under one contract.

The doing of all the work and furnishing all the stone, slabs, and brush, must be done by one contractor, though he may not furnish all other materials.

T. J. CRAM,
Colonel Corps Engineers, Brevet Major General.

Abstract of bids for furnishing materials and doing the work at Ausable

Number of bid.	Name and residence of bidders and bondsmen.	Manufactured materials bid for.				
		Class 1.	Class 2.	Class 3.—All kinds of iron		
		240 round piles.	All sawed timber and lumber, 1,104 520 ft. b. m.	Drift bolt iron, 67,360 lbs.	Spikes, 2,477 lbs.	Nails, 120 lbs.
		Per pile.		*Per lb.*	*Per lb.*	*Per lb.*
1	Backus Bros., Ausable, Mich.; Standart Bros., Detroit, bondsmen.	W. oak, $8; h. pine, $5; w. o. $1,920; pine, $1,200.	$24,851 70	....	....	....
2	James McGill, Ausable, Mich. No bondsmen offered in bid.	....	....	....	....	....
3	Carkin & Kimball, East Saginaw, Mich. No bondsmen offered in bid.	$2 90 696 00	*Per M.* $15 90 16,591 46	$0 05.9 3,974 21	$0 08 198 16	$ 07 8 40
4	Hasbrouck & Conro, Milwaukee, Wis.; A. Goodrich, Chicago, M. B. Medbury, Milwaukee, bondsmen.	4 00 960 00	1,005.648 ft. $20, $20,112 96; 98 872 ft. $16, $1,581 95.	7 4,715 20	10 247 70	8 9 60
5	H. M. Mixer, Monroe, Michigan; N. M. Brooks, Detroit, J. M. Sterling, Monroe, bondsmen.	4 95 1,188 00	18 00 19,881 36	6 4,041 60	8 198 16	8 9 60
6	Alex. McDonell & Co., Hamilton, C. W. No bondsmen offered in bid.	6 10 1,464 00	18 00 19,881 36	8 5,388 80	10 247 70	10 12 00
7	Harvey P. Platt, H. F. Stock, Toledo, Ohio; A. C. McNairy, Henry M. Clafflin, bondsmen.	....	....	....	....	....
8	Henry M. Loud, Detroit, whole or none. No bondsmen offered, but good promised.	3 50 840 00	17 90 19,770 90	5¼ 3,533 90	8 198 16	8 9 60
9	Loud, Priest & Gay, Detroit. No bondsmen offered, but good promised.	....	17 90 19,770 90	....	....	....

Abstract of bids for furnishing materials and doing the work

Number of bid.	Name and residence of bidders and bondsmen.	Work and labor
		Class A.*
		Filling cribs and superstructure—1,047 cords stone; 600 cords slabs or brush.
		Per cord.
1	Backus Bros., Ausable, Mich.; Standart Bros., Detroit, Mich., bondsmen.	....
2	James McGill, Ausable, Mich. No bondsmen offered in bid.	Stone, $12 00; $12,564 00
3	Carkin & Kimball, East Saginaw, Mich. No bondsmen offered in bid.	Stone, $17 90; slabs, $1 40; brush, $4 40. Stone, $17,799 00; slabs, $840 00; brush, $2,640 00.
4	Hasbrouck & Conro, Milwaukee; A. Goodrich, Chicago, M. B. Medbury, Milwaukee, bondsmen.	Stone, $18 00; slabs, $3 00; brush, $3 00. Stone, $18,846 00; slabs, $1,800 00 brush, ——.
5	H. M. Mixer, Monroe, Mich.; N. W. Brooks, Detroit, J. M. Sterling, Monroe, bondsmen.	Stone, $10 25; slabs, $1 50; brush, $1 25. Stone, $10,731 75; slabs, $900 00; brush, $750 00.
6	A. McDonell, Hamilton, C. W. No bondsmen offered in bid.	Stone, $14 00; slabs, $5 00; brush, $4 00. Stone, $14.658 00; slabs, $3,000 00; brush, $2,400 00.
7	H. P. Platt, H. S. Stock, Toledo, Ohio; A. C. McNairy, Henry M. Clafflin, bondsmen.	....
8	H. M. Loud, Detroit, (whole or none.) No bondsmen offered, but good promised.	Stone, $13 90; slabs, $2 90; brush, $2 90. Stone, $14,553 30; slabs, $1,740 00; brush, ——.
9	Loud, Priest & Gay, Detroit. No bondsmen offered, but good promised.	....

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* All below must necessarily be classed together, as all work

River, Lake Huron, harbor, for a depth of ten feet below ordinary low water.

Cost of class 1.	Cost of class 2.	Cost of class 3.	Total cost of all classes manufactured materials.	Work or labor classified and bid for. Class A.* Dred'ing to place cribs on an even bottom in 10 feet of water, 3,962 cubic yards.	Work or labor classified and bid for. Class A.* Framing cribs, boring, bolting, putting them in place, driving piles in their corners, und'r water work—7,200 r. f. piles, 66,440 r. f. square timber.	Work or labor classified and bid for. Class A.* Framing superstructure, boring, bolting, & fastening in place, above water—22,684 r. f. square timber.
				Per cubic yd.	*Per foot.*	*Per foot.*
W. oak, $1,920; H. pine, 1,200.	$24,851 70					
696 00	16,531 46	$4,180 80	$21,378 26	$0 44 1,743 28	$0 15 11,046 00	$0 14 3,175 76
960 00	21,694 91	4,972 50	27,627 41	32 1,267 84	7,200 r.f. piles, 16⅔ c., $1,200; 66,440 r. f. sq. timber, 11 c., $7,308 40.	11 2,495 24
1,188 00	19,881 36	4,219 36	25,318 72	40 1,584 80	10 7,364 00	10 2,268 40
1,464 00	19,881 36	6,098 50	27,443 86	55 2,179 10	8 5,891 20	7 1,587 88
				47 1,862 14		
840 00	19,770 90	3,744 66	24,355 56	40 1,584 80	12.9 9,499 56	9.9 2,245 78
	19,770 90					

at Ausable River, Lake Huron, harbor, &c.—Continued.

classified and bid for. Class A—Continued. Framing, fitting, and boring joists and plank; 70,552 feet b. m.	classified and bid for. Class A—Continued. Framing, fitting, and spiking scantling and bottom boards into cribs; 28,320 feet b. m.	Class B. Dredging channel between piers and just above piers in river; 24,919 cubic yards.	Cost of class A.	Cost of class B.	Total cost of work or both classes of labor.	Total cost of all classes of materials, work, or labor.
Per M. ft.	*Per M. ft.*	*Per yard.*				
$12 00 846 62	$12 50 354 00	$0 44 10,964 36	Slabs, $35,804 66 Brush, 37,604 66	$10,964 36	$46,769 02 48,569 02	$68,147 28 69,947 28
8 00 564 41	8 00 226 56	32 7,974 08	Slabs, 33,708 45	7,974 08	41,682 53	69,309 94
6 50 458 59	6 50 184 08	37 9,220 03	Slabs, 23,491 62 Brush, 23,341 62	9,220 03	32,711 65 32,561 65	58,030 37 57,880 37
14 00 387 72	12 00 339 84	40 9,967 60	Slabs, 28,643 74 Brush, 28,043 74	9,967 60	38,611 34 38,011 34	66,055 20 65,455 20
		39 9,718 41		9,718 41		
5 00 332 76	8 00 226 56	35 8,721 65	30,202 70	8,721 65	38,924 35	63,279 91

or labor cannot be separated in process of constructing pier.

Abstract of bids for furnishing materials and doing the work at Ausable river, Lake

Number of bid.	Name and residences of bidder and bondsmen.	Manufactured materials bid for.				
		Class 1.	Class 2.	Class 3—All kinds of iron.		
		240 round piles.	All sawed timber and lumber, 1,223,941 feet, b. m.	Drift bolt iron, 76,315 lbs.	Spikes, 2,477 lbs.	Nails, 120 lbs.
		Per pile.	*Per M.*	*Per lb.*	*Per lb.*	*Pr. lb.*
1	Backus Bros., Ausable, Mich.; Standart Bros., Detroit, bondsmen.	W. oak, $8 00; h. pine, $5 00; w. oak, $19 20; h. pine, $12 00.	$22 50 27,538 74	....	....	......
2	James McGill, Ausable, Mich. No bondsmen offered in bid.	....	....	....	....	......
3	Carkin & Kimball, East Saginaw, Mich. No bondsmen offered in bid.	2 90 696 00	15 90 19,460 71	$0 05.9 4,502 54	$0 08 198 16	$0 07 240 00
4	Hasbrouck & Conro, Milwaukee, Wis. A. Goodrich, Chicago, M. B. Medbury, Milwaukee, bondsmen.	4 00 960 00	1,125,072 ft. $20. $22,501 44. 98,872 ft., $16, $1,581 95.	07 5,342 05	10 247 70	08 960 00
5	H. M. Mixer, Monroe, Mich. N. M. Brooks, Detroit, J. M. Sterling, Monroe, bondsmen.	4 95 1,118 00	18 00 22,030 99	06 4,578 90	08 198 16	08 960 00
6	A. McDonell, Hamilton, C. W. No bondsmen offered in bid.	6 10 1,464 00	18 00 22,030 99	08 6,105 20	10 247 70	10 12 00
7	H. P. Platt, H. T. Stock, Toledo, Ohio. A. C. McNairy, Henry M. Claffiin, bondsmen.	....	....	....	....	......
8	H. M. Loud, Detroit, (whole or none.) No bondsmen offered, but good promised.	3 50 840 00	17 90 21,908 59	05¼ 4,006 53	08 198 16	08 960 00
9.	Loud & Priest, Detroit. No bondsmen offered, but good promised.	....	17 90 21,908 59	....	....	......

Abstract of bids for furnishing materials and doing the work

Number of bid.	Name and residence of bidders and bondsmen.	Work or labor
		Class A.*
		Filling cribs and superstructure—2,180 cords stone; 840 cords slabs or brush.
		Per cord.
1	Backus Bros., Ausable, Mich.; Standart Bros., Detroit, Mich., bondsmen.	....
2	James McGill, Ausable, Mich. No bondsmen offered in bid	Stone, $12 00; $26,160 00
3	Carkin & Kimball, East Saginaw, Mich. No bondsmen offered in bid.	Stone, $17 90; slabs, $1 40; brush, $4 40. Stone, $39,022 00; slabs, $1,176 00; brush. $3,696 00.
4	Hasbrouck & Conro, Milwaukee; A. Goodrich, Chicago, M. B. Medbury, Milwaukee, bondsmen.	Stone, $18 00; slabs, $3 00; brush, $3 00. Stone, $39,240 00; slabs, $2,520 00.
5	H. M. Mixer, Monroe, Mich.; N. W. Brooks, Detroit, J. M. Sterling, Monroe, bondsmen.	Stone, $10 25; slabs, $1 50; brush, $1 25. Stone, $22,345 00; slabs, $1,260 00; brush, $1.050 00.
6	A. McDonell, Hamilton, C. W. No bondsmen offered in bid....	Stone, $14 00; slabs, $5 00; brush, $4 00. Stone, $30,520 00; slabs, $4,200 00; brush, $3,360 00.
7	H. P. Platt, H. S. Stock, Toledo, Ohio; A. C. McNairy, Henry M. Claffiin, bondsmen.	....
8	H. M. Loud, Detroit, (whole or none.) No bondsmen offered, but good promised.	Stone, $13 90; slabs, $2 90; brush, $2 90. Stone, $30,302 00; slabs, $2,436 00; brush, $2,436 00.
9	Loud & Priest, Detroit. No bondsmen offered, but good promised	....

* All below must necessarily be classed together, as all work

I certify this to be a true abstract of the original bids.

Huron, harbor, for a depth of 12 *ft. below ordinary low water, crib-plan No.* 2.

Cost of class 1.	Cost of class 2.	Cost of class 3.	Total cost of all classes manufactured materials.	Work classified and bid for.		
				Class A.*		
				Dred'ng to place cribs on an even bottom in 12 ft. water, 6,480 cubic yards.	Framing cribs, boring, bolting, putting them in place, driving piles in their corn: r: under water work—7,200 r. f. piles, 76,032 r. f. square timber.	Framing superstructure, boring, bolting, & fastening in place above water, 22,684 r. f. square timber.
				Per cubic yd.	*Per foot.*	*Per foot.*
W. oak, $19 20 Pine.... 12 00						
696 00	$19,460 71	$4,709 10	$24,865 81	$0 44 2,851 20	$0 15 12,484 80	$0 14 3,175 76
960 00	24,083 39	5,599 35	30,642 74	32 2,073 60	7,200 ft., piles, 16½ c., $1,200. 76,032 ft. sq. timber, 11c., $8,363 52.	11 2,495 24
1,188 00	22,030 99	4,786 66	28,005 65	40 2,592 00	10 10,128 00	10 2,268 40
1,464 00	22,030 99	6,364 90	29,859 89	55 3,564 00	08 6,658 56	07 1,587 88
				47 3,045 60		
840 00	21,908 59	4,214 29	26,962 88	40 2,592 00	12.9 10,736 91	9.9 2,245 72

at Ausable River, Lake Huron, harbor, &c.—Continued.

classified and bid for.						
—Continued.		Class B.				
Framing, fitting, and boring joists and plank; 70,552 feet b. m.	Framing, fitting and spiking scantling and bottom boards into cribs; 28,320 feet b. m.	Dredging channel between piers & just above piers in river; 42,300 cubic yards.	Cost of class A.	Cost of class B.	Total cost of work or both classes of labor.	Total cost of all classes of materials, work, or labor.
Per M. ft.	*Per M. ft.*	*Per yard.*				
$12 00 846 62	$12 50 354 00	$0 44 18,612 00	Slabs, $59,910 38 Brush, 62,430 38	$18,612 00	$78,522 38 81,042 38	$103,388 19 105,908 19
8 00 564 41	8 226 56	32 13,536 00	56,683 33	13,536 00	70,219 33	100,862 07
6 50 458 59	6 50 184 08	37 15,651 00	Slabs, 39,236 07 Brush, 39,026 07	15,651 00	54,887 07 54,677 07	892 72 [illegible],682 72
987 73	12 00 339 84	40 16,920 00	Slabs, 47,858 00 Brush, 47,018 01	16,920 00	64,778 01 63,938 01	94,637 90 93,797 90
		39 16,497 00			16,497 00	
5 00 352 76	8 00 226 56	35 14,805 00	48,891 95	14,805 00	63,696 95	90,659 83

or labor cannot be separated in process of constructing pier.

T. J. CRAM, *Col. Engineers, Bvt. Maj. Gen.*

B 2.

UNITED STATES ENGINEER OFFICE,
June 15, 1867.

GENERAL: Since my letter of June 11 with abstract of bids Ausable harbor was forwarded, recommending awards to Carkin & Kimball (bid 3) for classes 1, 2, 3; to H. M. Mixer (bid 5) for class A, and to Hasbrouck & Conro (bid 4) for class B, trouble arises and comes from a practical attempt to carry out that construction of the law which supposes we may award to a contractor who has been the lowest bidder for each class of material or labor. Carkin & Kimball (3) consent to contract for classes 1, 2, 3, being the lowest for each; Hasbrouck & Conro (4) consent to contract for class B, being the lowest. But Mixer (bid 5) declines to contract for class A, though he was the lowest bidder, on the ground that he bid for the *whole or none.* I have called upon the next lowest bidder, Alex. McDonell & Co. (No. 6) for class A; they say, "Nay, we bid for the whole or none." I have called on the next lowest bidder for class A, H. M. Loud, (No. 8;) he says, "I bid for the whole or none," and declines taking A.

I have, therefore, upon this system of class contracting, no alternative but to call on the next lowest for A, Hasbrouck & Conro, (bid 4.) If I do call on them I have no doubt they will accept. You will see they bid for the whole.

Now let us figure up:

Carkin & Kimball get classes 1, 2, 3, costing the United States	$21,378 26
Hasbrouck & Conro get class B, costing the United States	7,974 08
Hasbrouck & Conro (if we give it to them) class B, costing the United States	33,708 45
Total cost of the work by class contract system	63,060 79

Now let us glance at the abstract:

Mixer's bid for the whole straight through (No. 5) is lowest	$57,880 37
H. M. Loud's bid for the whole straight through (No. 9) is next lowest	63,279 91
McDonell & Co.'s bid for the whole straight through (No. 6) is next lowest	65,455 20

It is therefore seen by the class system that the work will actually cost more, by $5,180 42, than it would if we gave the contract to Mixer, who is the lowest, for the entirety. In other words, while we are striving by the class system, by picking here and there from the bids, to save from the bidders, we are absolutely robbing the government in the present case of $5,180 42, which is more than ten per centum of the appropriation. Suppose by some time next week I may *coax* McDonald (the excellent Scotch mechanic) to consent to take A. This coaxing little becomes the dignity of the government, when there are so many good contractors who promptly come forward and bid upon the common-sense system for the entirety. If he consent, however—

Carkin & Kimball get classes 1, 2, 3	$21,378 26
Hasbrouck & Conro get class B	7,974 08
McDonald (if he can be coaxed) gets A	28,043 74
Total	57,396 08

This is lower than Mixer's lowest bid by $484 29. We should have three contractors, fifteen contracts to be written out, six bonds, nine bondsmen. And when Carkin & Kimball deliver classes 1, 2, 3, they will claim to be paid and be quit. Who then takes the risk and pays the storage and custodianship of these materials until they are put into the work? These are items of expense, and there will be extra expense besides on account of inspection, all far more than $484 29. But I have no expectation McDonald will accept of A.

Let us now consider the legality of awarding the entirety to Mixer, (bid No. 5,) who is the lowest responsible bidder for the whole work.

This harbor appropriation comes under the act approved March 2, 1867. In section two it reads: "Provided that no *contract* shall be made except after public advertisement for proposals, in such form and manner as to secure general notice thereof, and the same shall *only* be made with the lowest responsible bidder therefor." Now I admit there is some ambiguity as to what substantive noun the compound pronoun "therefor" refers to. If we go back, however, in the section, we shall find that it undoubtedly meant to refer to that part of the preceding proviso where it says, "and the money appropriated by this act *shall* be so applied as to complete or make the nearest approximation to completing the *work* for which each specific appropriation is made." I believe that "therefor" refers particularly to the work, and generally to the whole substantives in the sentence quoted; and the word work in the present application means the entire harbor at Ausable. Look at section two, act approved 23d June, 1866, and it will be seen the same interpretation is meant in this respect for the second sections of both acts.

Now it is certain that Mixer's bid for the work (the entire harbor) if accepted will enable us to reach further towards completing the work than we could by awarding to Carkin & Kimball and to Hasbrouck & Conro, by the sum of $5,180 42. It seems to me the law will only be fully complied with by contracting with Mixer for the whole, instead of awarding to Carkin & Kimball classes 1, 2, 3, and to Hasbrouck & Conro classes A and B.

Section 3 says: "There shall be separate proposals and separate contracts for each work;" also, "separate contracts for each class of material or labor." In my judgment the latter clause does not mean there shall be separate contractors for each class, but that in making out the instrument or writing denominated articles of agreement, there shall be specified or contracted for in the writing the classes of material or labor separately, which is tantamount to separate contracts for each class of material or labor.

I believe, however, that separate contractors might be contracted with for classes, provided their joint sums or bids should be less than the lowest for the whole work. As would be the case if Mixer would accept A, allowing Carkin & Kimball to have 1, 2, 3, and Hasbrouck & Conro B, for then the work would cost $52,693 96, less by $5,186 41 than Mixer's bid. Since Mixer and McDonald & Co. decline the awards for A, and under the interpretation of the law, as I view it, having now examined it in all its bearings upon these questions, I feel it my duty as a faithful officer to withdraw my recommendations of awards in my letter of June 11, and now to recommend that the whole be awarded to H. M. Mixer.

I do not see how else we can fully comply with the law, and at the same time *do justice* to the bidders.

I have the honor to be, very respectfully, your obedient servant,

T. J. CRAM,
Colonel Engineers, Brevet Major General.

Major General A. A. HUMPHREYS,
Chief of Engineers, U. S. Army.

B 3.

ENGINEER DEPARTMENT,
Washington, May 16, 1867.

SIR : The enclosed letter of the 7th instant from Brevet Major General T. J. Cram, United States army, colonel of engineers in charge of the improvement of the St. Clair flats, Michigan, is respectfully submitted, with an abstract of all the bids received in accordance with the printed copy of the advertisement appended thereto, inviting proposals for furnishing materials and for executing all work, including dredging of the channel.

General Cram recommends that the contract be awarded to John Brown, of Thorold, Canada West, for the execution of the entire work.

It will be observed by reference to the abstract that the lowest bidders for materials and labor are respectively as follows:

John Brown, Thorold, Canada West.—For piles, sawed and hewn timber, and for framing and putting in all sawed and hewn timber embraced in items one to fourteen, inclusive, of "materials required" and item four of "work to be done" under the advertisement.

Detroit Bridge and Iron Works Company, Detroit.—For one inch round-iron nut and screw and two washer bolts, items fifteen and sixteen of advertisement.

H. M. Mixer, Monroe, Michigan.—For bar-iron for drift bolts, items seventeen, eighteen, and nineteen of advertisement.

Buhl, Ducharme & Co., Detroit, Michigan.—For spikes, items twenty and twenty-one of advertisement.

George P. Sanborn, Milwaukee, Wisconsin.—For dredging channel, item one of "work to be done."

R. A. Conolly, Chicago, Illinois.—For preparing and driving round piles, item two of "work to be done."

W. W. & E. T. Williams, Manlius, New York.—For preparing and driving sheet piles, item three of "work to be done."

It is, therefore, recommended that the contracts for each class of material and labor be awarded to the parties enumerated, they being the lowest bidders, (and responsible.)

It is admitted that it would be convenient and advantageous to award the contract to the lowest bidder for the entire improvement, but this course would be setting aside the true intent of the law, which provides for separate contracts for each class of material and labor.

Again, by awarding the contracts separately it will be observed that the aggregate of the lowest bids amounts to the sum of $370,729 50. Whereas Mr. Brown's bid is $411,627 55, an excess of nearly $41,000 over the aggregate of the lowest bids, and for the item of dredging alone his bid is in excess $20,000.

It will be observed that the proposals are for the execution of the whole project, whereas the appropriation has been made for the execution of only one-half of the project.

It is, therefore, recommended that contracts be entered into only for so much of the material as may be advantageously used in executing the plan of improvement or as may be justified by the amount of the funds available—namely, $230,000, leaving sufficient of the appropriation for contracting for work to be done, including dredging.

Any other course would result in procuring a large amount of material without means of putting it in place until Congress should make a further appropriation.

Very respectfully, your obedient servant,

A. A. HUMPHREYS,
Chief of Engineers, Major General Volunteers.

Hon. E. M. STANTON, *Secretary of War.*

DETROIT, *May* 7, 1867.

SIR: I send herewith an abstract of all the bids on a large sheet, with a printed copy of my advertisement for the materials and work for ship canal across the St. Clair flats.

Eleven contractors came forward and bid for furnishing all materials and doing all the work as per my request in printed advertisements; all these, however, bidding according to the laws requiring bids separately for each kind of material and for each kind of work. Twenty-five more bidders bid partially, some for furnishing piles, some for the timber, and others for the iron, materials, &c. Those who bid for furnishing all materials and doing all the work, I collate from the abstract as follows:

Names of bidders and residence.	Total amount of bids for all materials and all work.
H. M. Mixer, Monroe, Michigan	$480,394 61
Ledlie & Corse, Chicago, Illinois	497,187 40
Harvey P. Platt, Toledo, Ohio	551,118 02
Walton & Fuller, Detroit, Michigan, and Springfield, Massachusetts	514,252 96
John Brown, Thorold, Canada West	411,627 55
Williams & Smith, Manlius, New York	482,206 87
R. A. Conolly, Chicago	453,398 58
Fox & Howard, Chicago	476,063 33
Hasbrouck & Conro, Milwaukee	463,675 59
Burt & Glasby, East Saginaw Michigan	466,574 14
George P. Sanborn, Milwaukee	420,894 58

The estimate of the probable cost, as seen in my report of December 10, 1866, upon which Congress directed this plan to be adopted, is $428,754.

Two of the above bids are below my estimate. The contractors making these bids are acknowledged to be the most experienced in similar work of all the others who have come in competition with them. Mr. Brown is the lowest bidder, and is represented as eminent in experience and abundant in means and every way highly responsible. He is the contractor who dredged for the Welland canal. He is the same who secured last season the contracts for Saginaw and St. Mary's rivers. I have no hesitation in recommending the contract for the St. Clair flats to be given to him on the above bid, and request the approval of the proper authority and instructions to forthwith make the contract with him.

My absence at Baltimore so long, under the orders of the War Department, has put me back some twenty days in everything.

There should be only one contractor on such a work, for all work and material.

Very respectfully, your obedient servant,

T. J. CRAM,
Colonel Corps Engineers, Brevet Major General.

Major General A. A. HUMPHREYS,
Chief of Engineers.

To Contractors.

OFFICE LAKE HARBOR IMPROVEMENTS,
111 *Griswold street, Detroit, Michigan.*

Written and sealed proposals for furnishing materials and doing the work will be received at this office, addressed to the undersigned, until the 10th day of April, 1867, for constructing a straight ship canal from the mouth of South Pass directly across the St. Clair flats, 300 feet wide and 13 feet deep, below lowest stage water, to be diked with piles and timber on each side for its whole length to a height of five feet above water, and the earth dredged out to form the canal to be put into the dikes and beyond them, so as to form the canal banks even in height with the dikes and of uniform width on top, and having an outer slope going off into the lake water of two horizontal to one vertical. For further details of construction, bidders are informed that they must be in person at this office, where models, drawings and specifications can be seen and all explanation given.

MATERIALS REQUIRED.

1. Five thousand one hundred and eighty rock elm or white oak straight round piles, 12 inches at least, exclusive of bark, in diameter at the middle, and not less then 28 feet long.

2. Sixteen thousand four hundred sheet piles, 4 by 12, sawed, 18 feet long, white oak, rock elm, hard or white pine, that will drive well without splitting, width may vary from 10 to 12 inches, giving an equivalent amount in board measure to what 12 inches in width would give for the total amount.

3. Eight hundred and sixty-four stringers, 5 by 6, sawed, 20 feet long, hard pine.

4. Eight hundred and sixty-four water-sills, 8 by 9, sawed, 20 feet long, hard or white pine.

5. Eight hundred and sixty-four water sills, 6 by 12, sawed, 20 feet long, hard or white pine.

6. Eight hundred and sixty-four binders, 4 by 6, sawed, 19 feet long, hard or white pine.

7. Eight hundred and sixty-four fenders, 8 by 12, sawed, 20 feet long, white oak or hard pine.

8. Eight hundred and sixty-four front caps, 12 by 12, sawed, 20 feet long, heart of white oak or of hard pine.

9. Eight hundred and sixty-four back caps, 8 by 8, sawed, 19 feet long, hard or white pine.

10. One thousand six hundred and forty front sidings, 10 by 12, sawed, 20 feet long, hard or white pine.

11. One thousand eight hundred and twenty-two front sidings, 10 by 12, sawed, 18 feet long, hard or white pine.

12. One thousand six hundred and forty rear sidings, 8 by 12, sawed, 20 feet long, hard or white pine.

13. One thousand eight hundred and twenty-two rear sidings, 8 by 12, sawed, 18 feet long, hard or white pine.

14. Six thousand four hundred and ninety-five cross-ties, 8 by 10, sawed, 14 feet long, hard or white pine or white oak.

The sawed stuff will amount to 3,684,278 feet board measure. The round piles to be of best quality of timber, all sawed stuff, to be squarely and truly sawed to the dimensions stated, of good live timber, and to be free from rotten knots, splits, shakes, or other defects tending to impair its durability or strength.

State the price in the bids for furnishing item 1, per pile delivered; state the price in the bids per thousand feet board measure, for furnishing all the sawed stuff delivered, the place of delivery being at the mouth of the South Pass, near "Jerry's ranch."

15. Two thousand five hundred and ninety one-inch round iron nut and screw (and two washers) bolts, 27 inches long from outside of head to point of screw.

16. Two thousand five hundred and ninety one-inch round iron nut and screw (and two washers) bolts, 25 inches long from outside of head to point of screw.

NOTE.—These bolts may probably have to be varied from one-half to one inch in length to suit variations in thickness of pile.

17. Six hundred and forty-eight bars one-inch square iron, 12 feet long, for drift-bolts, 25,754 pounds.

18. Six hundred and forty-eight bars one-inch square iron, 14 feet long, for drift-bolts, 30,046 pounds.

19. Five thousand eight hundred and twenty-eight bars one-inch square iron, 16 feet long, for drift-bolts, 308,837 pounds.

20. One thousand seven hundred and twenty-four pounds ten-inch wrought spikes, half inch in diameter.

21. Sixteen thousand nine hundred and forty-four pounds eight-inch wrought spikes, three-eighths inch in diameter.

The iron for the bolts and spikes to be of the best quality.

State the price per pound for furnishing and delivering items 15 and 16.

State the price per pound for furnishing and delivering items 17, 18 and 19.

State the price per pound for furnishing and delivering items 20 and 21.

The place of delivery being the same as above stated.

One sixteenth part of each class of the twenty-one foregoing items to be delivered on or before the 1st of July next, and the remainder in instalments of one sixteenth for every month thereafter during navigation until all shall have been delivered.

Whoever receives the contract will be required to furnish two responsible indorsers in a bond of indemnity to the United States to the amount of twenty per cent. of the total value of the materials contracted for.

State in the bids the names in full, and residence of the bondsmen.

WORK TO BE DONE.

1. The average depth of water all along where the canal is to be made was 6 feet 2½ inches last November, and nowhere less than 3½ feet, allowing scows to work with facility everywhere on and about the site.

The average thickness of the stratum or prism of earth to be excavated between the dikes is 6 feet 9½ inches; the mean lift to raise it to the surface of the water is 9 feet 7 inches. The length of the canal is to be 8,200 feet.

Borings show earth easy of dredging and good for driving the piles; should it be found hard to drive through the upper crust, dredging will be done along where the dikes are to stand, to a sufficient depth to allow the piles to be driven to the depth of 24 feet below the surface of the water for the round and 17 feet for the sheet piles.

Earth to be dredged from between the dikes and put into the dikes and into the canal banks beyond, so as to make them into proper shape as described, 618,280 cubic yards; probable amount to be dredged to ease the driving of the piles, 35,000 cubic yards. State the price per cubic yard, measured in the natural bed or cut, for so dredging and placing the earth. Also, state the price per cubic yard measured in the dikes and banks for so dredging and placing the earth.

2. State the price for preparing and driving the round piles per pile.

3. State the price for preparing and driving the sheet piles per pile.

4. State the price for framing and putting in place, according to plans and specifications to be learned in this office, all the sawed timber, per running foot of timber of each size measured in the works, there being 4 by 6, 16,416 running feet; of 5 by 6, 17,280 running feet; of 8 by 8, 16,416; of 8 by 9, 17,280; of 8 by 10, 90,930; of 6 by 12, 17,280; of 8 by 12, 82,876; of 10 by 12, 65,596; of 12 by 12, 17,280—mill measure; in all 341,354 lineal feet.

The framing is exceedingly simple; all can be done with the adze, hand-saw and auger. For every bolt to be driven, a hole must be previously bored to a depth equal to the length of the bolt. A dovetail is to be cut on each end of the cross-ties, and corresponding notches in the embracing timbers. In the running timber work the ends of the siding timbers are to abut, not lap, except the caps, fenders and water-sills, which are to join by halving. In each sheet-pile three spikes are to be driven without splitting, which will require previous boring.

It is highly desirable that one contractor should be fortunate in putting in his bids so as to secure to himself the contract for furnishing all materials and doing all the work. The doing of all the work, however, to be under one contractor, if bids justify. The act of Congress making the appropriation requires bids to be received and contracts made for each class of materials and for doing the work separately, and it may happen that he who gets the materials may not get the contract for the work. The lowest responsible bid secures the contract.

It is pertinent to remark that from the beginning of the work at South Pass, to the completion, all the machinery and work will be, in almost all weather, perfectly protected, nor will any hindrance arise from passing vessels or rafts, which, until the new channel shall be completed, will follow the old crooked route across the flats. These circumstances are of great consideration to the contractor.

The rule which has already been stated in reference to bondsmen and indemnity for materials applies to the contract for doing the work. Bidders will be particular to follow the instructions herein contained in writing out their proposals. Time for completing the work, on or before the spring of 1869.

T. J. CRAM,
Col. Corps Engineers, Bvt. Maj. Gen. U. S. A.,
Sup't Harbor and River Improvements.

B 4.

ENGINEER DEPARTMENT,
Washington, May 21, 1867.

GENERAL: Your letter of the 17th instant, with abstract of proposals for work at St. Clair flats, was submitted to the Secretary of War, with recommendations from this department, which have been approved by him. You will therefore proceed to award the contracts to the lowest responsible bidders "for each class of material and labor," as provided for in the third section of the act approved March 2, 1867, upon their furnishing the requisite security for the faithful performance of the same.

It will be seen by reference to the abstract of proposals, that the lowest bidders for materials and labor are respectively as follows:

John Brown, Thorold, Canada West.—For piles, sawed and hewn timber, and for framing and putting in all sawed and hewn timber embraced in items 1 to 14 (inclusive) of "materials required," and item 4 of "work to be done," under the advertisement.

Detroit Bridge and Iron Works Company, Detroit.—For 1-inch round iron nut and screw two-washer bolts, items 15 and 16, advertisement.

H. M. Mixer, Monroe, Michigan.—For bar iron for drift bolts, items 17, 18, and 19, advertisement.

Buhl, Ducharme & Co., Detroit, Michigan.—For spikes, items 20 and 21, advertisement.

George P. Sanborn, Milwaukee, Wisconsin.—For dredging channel, item 1 of work to be done.

R. A. Conolly, Chicago, Illinois.—For preparing and driving round piles, item 2 of work to be done.

W. W. and E. T. Williams, Manlius, New York.—For preparing and driving sheet piles, item 3 of work to be done.

You will enter into contracts only for so much of the material as may be advantageously used in executing the plan of improvement to the extent practicable with the appropriations made for it, namely, $230,000, leaving sufficient of that sum for the contract for work to be done, including dredging. Any other course would result in procuring a large amount of material without the means of putting it in place until Congress should make further appropriation.

Very respectfully, your obedient servant,

A. A. HUMPHREYS,
Brig. Gen. and Chief of Engineers, Maj. Gen. Volunteers.

Brevet Major Gen. T. J. CRAM, U. S. A.,
Colonel of Engineers, Detroit, Michigan.

B 5.—*Abstract of bids for St. Clair flats*

Number of bid.	Names of bidders.	For furnishing materials.				
		5, 180 piles.	All sawed or hewed timber –3,684,276 ft. board measure.	5,180 1-inch round nut and screw (2 washer) bolts—37,555 lbs.	7,124 bars 1-inch square iron for drift bolts—364,637 lbs.	18,668 lbs. spikes, 8 and 10 inches long, ½ in. and ⅝ in. diameter.
		Per pile.	*Per M.*	*Per lb.*	*Per lb.*	*Per lb.*
	H. M. Mixer, Monroe, Mich	$6 25	$22 00	$0 09½	$0 05	$0 07½
2	Joel W. Kelsey, Toledo, Ohio	4 48	....	....	....	....
3	Loud, Priest & Gay, Ausable, Mich	6 50	25 00	....	....	....
4	Gilbert W. Ledlie, East Saginaw	....	....	9. 9	5. 9	7. 3
5	Ledlie & Corse, Chigago, Ill	4 00	19 90	12	7½	8½
6	Harvey P. Platt, Toledo, Ohio	4 75	26 00	9	6½	9
7	H. M. Loud, Detroit, Mich	6 50	Unintelligi	ble and no	t in accord	ance with
8	D. E. Rice, Detroit, Mich	....	....	8½	5½	....
9	Walton & Fuller, Detroit, Mich	6 00	28 00	12½	7	8
10	Alex. McDonnell, Hamilton, C. W	4 50	22 00	Each 1 15	6½	9
11	Wm. Sanborn, Port Huron Mich	5 00	24 00	....	....	....
12	John Brown, Thorold, C. W	3 20	19 00	11	5½	8
13	Brooks & Adams, Detroit, Mich	....	20 00	....	....	....
14	Buhl, Ducharme & Co., Detroit, Mich	....	....	9	5½	7
15	Detroit Bridge and Iron Works Co., Detroit, Mich.	....	....	7½	5½	....
16	W. W. Williams & Smith, materials, and W. W. & E. T. Williams, work, Manlius, N. Y.	4 00	24 70	11	6	9
17	Eugene St. Amour, Detroit, Mich	6 00	....	....	....	....
18	Elias Sims, Cleveland, Ohio	4 00	....	....	....	....
19	R. A. Conolly, Chicago, Ill	4 20	22 00	13	8	12½
20	Fox & Howard, Chicago, Ill	4 00	20 00	12½	6	9½
21	Hasbrouck & Conro, Milwaukee, Wis	3 75	23 00 piles only.	12	7½	10½
22	Henry C. Kibbee, Detroit, Mich	3 80	....	....	....	....
23	J. M. Jones, Detroit, Mich	5 00	23 00	9	5½	7½
24	Burt & Glasby, East Saginaw, Mich	3 92	20 00	14	8	10
25	Farquhar McRae, Wallaceburg, C. W	3 88	....	....	....	....
26	Mason, Doty & Luce, Detroit, Mich	....	22 40	....	....	....
27	John Trowbridge & Bros., Detroit, Mich.	6 16	22 00	....	....	....
28	John C. Valentine, East Saginaw, Mich	....	*19 00	....	....	....
29	L. M. Mason, Detroit, Mich	....	21 90	....	....	....
30	Seth P. Cushman, Detroit, Mich	3 25	....	....	....	....
31	A. A. McDonnell, Hamilton, C. W	5 60	....	....	....	....
32	George P. Sanborn, Milwaukee, Wis	3 50	24 00	14	7½	10
33	L. Reeve, East Saginaw, Mich.	....	20 95	....	....	....
34	E. Vonderbecke, Detroit, Mich	3 75	....	....	....	....
35	Balphe C. Smith, Detroit, Mich	3 50	....	....	....	....
36	Milton H. Butler, Detroit, Mich	3 45	....	....	....	....

* All to be delivered in rafts. This condition vitiates bid.

Michigan.—Ship canal, straight cut.

For doing work.												
				For framing and putting in, per running foot.								
Dredging per cubic yd., measured in the cut or bed—653,280 yards.	Dredging per cubic yd., measured in the dikes or banks—653,280 yds.	For preparing and driving the round piles.	For preparing and driving the sheet piles.	Binders, 4 in. by 6 in., 16,416 r. ft.	Stringers, 5 in. by 6 in., 17,280 r. f.	Back caps, 8 in. by 8 in., 16,416 r. ft.	F. water sills, 8 in. by 9 in., 17,280 run. feet.	Cross-ties, 8 in. by 10 in., 90,930 run. feet.	B. water sills, 6 in. by 12 in., 17,280 run. feet.	Fenders, b. sid'gs, 8 in. by 12 in., 82,876 run. feet.	Front siding, 10 in. by 12 in., 65,596 run. feet.	Front caps, 12 in. by 12 in., 17,280 run. ft.
$0 40	$0 45	*Per pile.* $3 00	*Per pile.* $1 00	$0 15	above	water,	20 cents	below w	ater, per	lineal foo	t.	
44	44	5 90	1 40	8	$0 08	$0 10	$0 16	$0 09	$0 16	Fenders, 16 c. r. siding, 10 c.	$0 11	$0 11
....	....	....	....	....	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	....	....	....	....	....
44	....	2 99	1 24	10	10	14	14	14	14	$0 14	14	14
48½	55½	5 00	1 25	6	6½	7½	9	10½	10	12	15	16
pecifica	tions in	advertis	ement.									
....	....	....	....	....	....	....	....	....	....	....	....	....
45	60	3 50	75	7	7	7	7	7	7	7	7	7
....	....	3 00	1 25	5	5	5	5	5	5	5	5	5
....	....	....	....	....	....	....	....	....	....	....	....	....
38	39	2 80	1 30	4½	4½	4½	4½	4½	4½	4½	4½	4½
....	....	....	....	....	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	....	....	....	....	....
44	....	3 50	60	6	6	8	8	7	7	9	9	10
....	....	3 00	75	....	....	....	....	....	....	....	....	....
56	57	3 20	....	....	....	....	....	....	....	....	....	....
40	....	2 00	72	9	9	9	9	9	9	9	9	9
44½	44½	2 50	75	2½	3	6½	7½	8	7½	9½	12	14½
42	....	2 25	65	8½	8½	8½	8½	8½	8½	8½	8½	8½
50	....	....	....	....	....	....	....	....	....	....	....	....
50	....	2 90	....	6 cts.	per fo	ot abo	ve and	12 below	water.			
44	....	†1 40	81	8	8	8	8	8	8	8	8	8
....	....	....	....	....	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	....	....	....	....	....
....	....	4 20	....	....	....	....	....	....	....	....	....	....
34½	....	2 25	69	9½	9½	9½	9½	9½	9½	9½	9½	9½
....	....	....	....	....	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	....	....	....	....	....

† Bids for driving not accepted on account of condition.

Abstract of bids for St. Clair flats,

Number of bid.	Names of bidders.	Cost of -				
		Piles.	Timber.	Washer bolts.	Drift bolts, iron.	Spikes.
1	H. M. Mixer, Monroe, Mich	$32, 375 00	$81, 054 11	$3, 567 72	$18, 231 85	$1, 353 43
2	Joel W. Kelsey, Toledo, Ohio	23, 206 40				
3	Loud, Priest & Gay, Ausable, Mich	33, 670 00	92, 106 95			
4	Gilbert W. Ledlie, East Saginaw, Michigan					
5	*a* Ledlie & Corse, Chicago, Ill	20, 720 00	73, 317 13	4, 506 60	27, 347 77	1, 586 78
6	Harvey P. Platt, Toledo, Ohio	24, 605 00	95, 791 22	3, 379 95	23, 701 40	1, 680 12
7	H. M. Loud, Detroit, Michigan					
8	D. E. Rice, Detroit, Mich			3, 192 17	19, 599 23	
9	*b* Walton & Fuller, Detroit, Mich	31, 080 00	103, 157 78	4, 694 37	25, 524 59	1, 493 44
10	Alex. McDonnell, Hamilton, C. W	23, 310 00	81, 054 11	5, 957 00		
11	Wm. Sanborn, Port Huron, Mich					
12	John Brown, Thorold, C. W	16, 576 00	70, 001 28	4, 131 05	19, 143 44	1, 493 44
13	Brooks & Adams, Detroit, Mich					
14	Buhl, Ducharme & Co., Detroit, Mich			3, 379 95	18, 687 64	1, 306 76
15	Detroit Bridge & Iron W'ks Co., Detroit, Mich			2, 816 62	18, 687 64	
16	*c* W. W. Williams & Smith, materials, W. W. & E. T. Williams, work, Manlius, N. Y.	20, 720 00	91, 001 66	4, 131 05	21, 878 22	1, 680 12
17	Eugene St. Arnour, Detroit, Mich					
18	Elias Sims, Cleveland, Ohio					
19	R. A. Conolly, Chicago, Ill	21, 756 00	81, 054 11	4, 882 15	29, 170 96	2, 333 50
20	Fox & Howard, Chicago, Ill	20, 720 00	73, 685 56	4, 694 37	29, 070 96	1, 773 46
21	Hasbrouck & Conro, Milwaukee, Wis	19, 425 00	Piles, 27, 158 40	4, 506 60	27, 347 77	1, 960 14
22	Henry C. Kibbee, Detroit, Mich					
23	J. M. Jones, Detroit, Mich					
24	Burt & Glasby, East Saginaw, Mich	20, 305 60	73, 685 56	5, 257 70	29, 170 96	1, 866 80
25	Farquhar McRae, Wallaceburg, C. W					
26	Mason, Doty & Luce, Detroit, Mich					
27	*d* John Trowbridge & Bros., Detroit, Mich					
28	John C. Valentine, East Saginaw, Mich					
29	L. M. Mason, Detroit, Mich					
30	Seth P. Cushman, Detroit, Mich					
31	A. A. McDonnell, Hamilton, C. W					
32	George P. Sanborn, Milwaukee, Wis	18, 130 00	88, 422 67	5, 257 70	26, 436 18	1, 866 80
33	L. Reeve, East Saginaw, Mich					
34	E. Vonderbecke, Detroit, Mich					
35	Ralph C. Smith, Detroit, Mich					
36	Milton H. Butler, Detroit, Mich					

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[a] Bids for dredging not in accordance with advertisement. For all materials rehandled in dikes, 15 cents extra per yard.

[b] Wants explanation of measurement in embankment.

[c] If the earth is measured in scows, deduct 2 cents per yard. Too many conditions in bid for dredging.

[d] Will only furnish 1,000 piles. This condition vitiates bids for piles.

Michigan.—Ship canal, straight cut—Continued.

Cost of—					Total cost of material.	Total cost of work.	Total.
Dredging, measured in cut.	Dredging, measured in dikes.	Preparing and driving round piles.	Preparing and driving sheet piles.	Framing sawed timber.			
$261,312 00	$293,976 00	$15,540 00	$16,400 00	$50,560 00	$136,582 11	$343,812 50	$480,394 61
287,443 20	287,443 20	30,562 00	22,960 00	36,491 34	....	....	....
....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....
287,443 20	....	15,488 20	20,336 00	46,441 72	127,478 28	369,709 12	497,187 40
316,840 80	....	25,900 00	20,500 00	38,719 53	149,157 69	401,960 33	551,118 02
....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....
293,976 00	391,968 00	18,130 00	12,300 00	23,894 78	165,952 18	348,300 78	514,252 96
....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....
248,246 40	254,779 20	14,504 00	21,320 00	16,215 47	111,341 68	300,285 87	411,627 55
....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....
287,443 20	....	18,130 00	9,840 00	27,382 62	139,411 05	342,795 82	482,206 87
....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....
261,312 00	....	10,360 00	11,808 00	30,721 86	139,196 72	314,201 86	453,398 58
29,709 60	290,709 60	12,950 00	12,300 00	30,069 38	130,044 35	346,028 98	476,063 33
274,377 60	....	11,635 00	10,660 00	29,015 09	....	325,697 69	....
....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....
287,443 20	....	7,252 00	13,284 00	27,308 32	131,286 62	335,287 52	466,574 14
....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....
225,381 60	....	11,655 00	11,316 00	32,428 63	140,113 35	280,781 23	420,894 58
....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....

I certify this to be a true abstract of the original bids.

T. J. CRAM,
Colonel of Engineers, Brevet Major General U. S. A.

B 6.

UNITED STATES ENGINEER OFFICE,
Detroit, June 11, 1867.

GENERAL: In justice to the engineer department I admit that the abstract of bids sent with my letter of May 7th last recommended the award for all materials and work to John Brown. Bid No. 12 was made out in this office, in a manner which, *with an omission of facts* not then known, but since discovered, may have misled, and been the cause of the engineer department letter, May 21, being sent to me, to the end of awarding contracts for the canal to seven (7) different persons. The letter seems to take it for granted that the seven named will take the respective contracts for the several items specified.

We shall see how far such a supposition may be realized. I have made out a corrected abstract, and classified the work and materials in accordance with what I regard a proper construction of the law in reference to this particular work. This abstract I desire to replace the one I before sent, and to have that returned to my office. I transmit the corrected one as my final official return herewith. As to awarding the iron to bid No. 1, (H. M. Mixer,) bid No. 12 (John Brown) is as low as Mixer's, and, besides, Mixer declines upon the honest ground that he bid for the "whole or none." As to awarding the nut and screw washer bolts and bar iron (round) to Detroit Bridge and Iron Works Company, (bid No. 15,) it will be seen that Brown's bid for these is as low as bid No. 15, and as that company expresses indifference to receiving the contract, on the ground of risk and inconvenience of delivering, I see good reasons for awarding it to John Brown.

As to awarding the contract for spikes to Buhl, Ducharme & Co., (bid No. 14,) it will be seen that Brown's bid, No. 12, is as low as Buhl, Ducharme & Co.'s bid for these spikes; and as Buhl, Ducharme & Co. express indifference to the contract, on account of risk in sending (to a place where they or the government have no storehouse) kegs of the articles, there seems good reason to award the contract to Brown for the spikes. The iron bolts and spikes constitute one "class" of material, and by making a contract for it with Brown we comply with the law in awarding this class of material to him, who is the lowest bidder for all in the class.

As to awarding the contract to R. A. Conolly, (bid No. 19,) his bid was for the whole or none, so understood; besides, though he might be a responsible bidder for the whole straight through, he is not a responsible contractor for driving these piles, as would be required, at $2 each, under an isolated job, apart from the rest of the work he bid for. Such a price is unreasonable, nor would he take the contract for driving alone. On account of unreasonableness, article 1046 Army Regulations, Revised, tells us that part of the bid which refers to driving the piles should be rejected; and, besides, there is another reason: much dredging will have to be done to facilitate the driving. Who does this, if an independent contract be made for the driving alone? The truth is, we can't separate the dredging from the rest of the work of putting in the woodwork of the dikes, and afterwards securing them. This is a reason for putting the driving of the piles and all other work, including the dredging, under one class, designated Class A in the abstract. Each and every reason just assigned would apply to every bid below $5 per pile for driving, if we award for driving alone, independently of the other work to be done. Hence, we can only regard Brown's bid as the lowest we can take to make a contract upon, and we can do that only upon the ground of his having the award of all other work. Brown's bid is the lowest—I may say, the only—bid for driving the round piles that we can hope to contract for.

In regard to driving sheet-piling, precisely the same reasons, each and every, apply to them as for the round piles, and more besides. These cannot be driven and spiked in a job disconnected with sawed timber-work of the dikes. No person could be induced to take a contract for doing it (unless he has the contract for the whole work) at any reasonable price. Brown's is the lowest reasonable, responsible bid that the preparing, driving, and spiking can be done for, and that, too, in connection with other work. What does the preparing mean? Brown was the only one of the contractors who examined the model and could take in all the measuring; who had the wit to discover that the sheet-piles would have to be jointed with a plane on both edges. Now, to joint an oak stick on both edges, eighteen feet long, twelve inches wide, and four inches thick, is no small job. Williams bid for the award of all he bid for, or none, (bid No. 16.) He therefore declines the contract, virtually, for driving sheet-piles, and the same is the case with every other bidder unless he can have the whole he bid for awarded to him.

We now come to the question of awarding the dredging to George P. Sanborn, Milwaukee, (bid No. 32.) In relation to this bid there is considerable to be said. Some days after sending my letter of May 7, with the abstract of bids, I discovered that this was a fraud, which had I known when I opened the bids I would have rejected in toto, and it should never have appeared on an abstract of mine. The evidence of this piece of sharp practice became conclusive some days since. Conro (who bid No. 21) drew up bid 32, signed Sanborn's name, and put it in, not for Sanborn to get the contract, but for Hasbrouck & Conro to get the dredging, provided their bid (No. 21) should fail to be the lowest. It proves that Sanborn was a "straw," used by Conro to obtain for Hasbrouck & Conro the advantage of two bids to each of their fellow bidders having one; and this was all unknown to me until since the abstract was made out and my letter of 7th May was sent. I find that Sanborn used to be a bookkeeper to Conro, and knows no more about constructions than the most inexperienced. Conro has seen me twice since, and acknowledged, when I charged him with perpetrating the trick, that he did it so as to secure to himself the dredging in case his bid (No. 21) should fail to secure the whole. There never has been a word, verbally or in writing, from Sanborn to me, claiming the contract or acknowledging the bid, or conferring any authority for Conro to use his (Sanborn's) name in a manner which, without such written authority, is tantamount to a forgery. I stamp this "straw" bid (No. 32) as a transaction worthy of a trickster. Conro, first, on seeing that Brown, for the entirety was the lowest, went and proposed to Brown to take him (Conro) in as partner on Brown's bid. Brown's reply was that "the contract had not yet been awarded, consequently he could give no definite reply to such a proposition." Conro has since been active to secure for himself the dredging on the fraudulent bid in the name of Sanborn, and the pertinacity of his acts show a desire more for a haul upon the public crib than for the interest of this important public work. I regard his use of a "straw" bidder as an unfair attempt to overreach those who put in their bids honestly, according to the understanding. Conro has had the barefacedness recently to call on me a third time, claiming that I should award the dredging to Sanborn, in order that he (Conro) might get the contract. Never presenting any authority, written or verbal, from Sanborn for anything concerning bid No. 32, or anything else. It is needless to say I have treated this claim of Conro with silence; and now, in making up my final abstract herewith sent, I mark upon the abstract a rejection of the whole bid, (No. 21,) for reasons herein stated and thereon assigned, under the head of remarks.

As to awarding the items specified in engineer department letter, May 21, to John Brown: The letter arrived at my office during my absence at Buffalo, and was opened under the instructions I left, for opening all official letters by my clerk. Brown called to see about the award, and the letter was shown to him. He replied: "I can't take such a contract; my bid was for the whole or none, the same as all who bid for the entirety. Nobody can expect that such a work can be carried on by several contractors. One can do the work well, according to the general's plan; two would be in each other's way, and would inevitably clash." I have not seen Mr. Brown since, but he left this message as his official reply to the proposition of awarding him parts of his bid instead of the whole.

I have now reported in full upon the proposition in engineer department letter of May 21, to assign the work to seven contractors, and the conclusion is clear that we cannot expect to accomplish the object by assigning contracts for different "kinds" of material or different "kinds" of work, but that we could have secured a highly favorable contractor for the interest of the work by assigning the contract by classifying the labor or work, and by "classifying" material, as contemplated in the law, according to my construction, and as I have done in my final abstract, after a careful reperusal of all the bids.

The law says, "no contract shall be made except after public advertisement for proposals, &c., and the same shall only be made *for the work,* (work meaning in this case ship canal, St. Clair flats,) with the lowest responsible bidder therefor, upon security deemed sufficient in the judgment of the Secretary [of War."] Now, this don't oblige contracts to be made for different *kinds* of *labor* or *work,* nor for different *kinds* of material. Now, in regard to section three, "there shall be separate proposals, and separate contracts for each work, and also for each *class* (not *kind*) of labor, and also for each *class* (not kind) of material for each work." Now, I do not infer this to mean there shall be separate contractors even for each *class* of labor or material. Much less do I infer that it means separate contractors for each kind of labor or each kind of material, but that it does mean that in drawing up the instrument called contract there shall be stated in it separate classes of labor and of material specified and contracted for, so that kinds, quantities of measure or weight, and prices, &c., may be clearly understood, and thus avoiding the former system of lumping, so liable to frauds, and injustice to the public interest, and whereupon many of the piers were so slightingly constructed. I hold this to be a sound interpretation applicable to every work coming under that law generally. Now, in regard to the particular work (ship canal, St. Clair flats) under consideration, there is another feature of the law, which says the money shall be applied to carrying out a certain plan. The plan, to be properly executed, must be done by putting all work of whatsoever kind in it under one contractor; it is for this reason that I classify in the abstract all work to be done in one class, A. The materials are classified into three. The propriety of giving all three of these classes to the same contractor, who has class A, may have not been so obvious to the engineer department as I will now make it. We have no storehouse, no dock, no boom, at the place where the work is to commence. Suppose we contract with three different contractors for the materials to be delivered. Each delivers; we are bound to receive and pay. Who is, after delivery to the United States, to have the care, or to store, or to guard, so much valuable property at that point, where there is not a house, dock, or inhabitant within several miles? You must see the risk to the United States would be very great. Put all the materials and work under one responsible contractor: he makes his own dock, storehouses, shop, and boom, and relieves the government from all risk, and expense of custodianship for materials. I should take care to draw the contract with a clause to this end; also, with a clause to fill the condition in the last paragraph but one of your May 21 letter. It will be seen by the abstract that Brown (bid No. 12) is as low and lower than anybody else's bid upon class one, class two, class three, and for class A; he is lower than any other honest, bona fide, responsible bidder. I hold that under the law he is entitled to the contract for the work, as a whole. I also hold that under the law he is entitled to the award for each class, not only of materials, 1, 2, 3, but likewise for the class of labor, A, since the bid 32 is rejected in toto, and utterly discarded. Even if it were admitted among honest bids, Brown, under the law, would be entitled to the award, upon the ground, "and the same (contract) shall only be made for the work with the lowest responsible bidder therefor." Now as to security. Before writing my recommendation of 7th May, Brown presented satisfactory names to me, and I doubt not they will be perfectly satisfactory to the Secretary of War, as his bondsmen. He went so far as to say, "I will, if required, put in deposit in gold, in the government bank at Detroit, funds to any amount you may require, to the credit of the work, as additional security." I cannot say that Brown will, now it has become so late, accept the contract; but I think he would if awarded to him in the same good faith in which he bid. For reasons and facts herein given, I submit the matter and recommend that the award of all be made to John Brown (bidder No. 12) for the whole work, and that I be authorized to draw up the contract as soon as possible, or we shall consume another season in preliminaries to another annual detriment to the commerce to the amount of half a million of dollars, more than enough to construct the whole work.

I have the honor to be, very respectfully, your obedient servant,

T. J. CRAM,
Colonel Engineers, Brevet Major General.

P. S.—The letter to which this is in reply came while I was absent in Buffalo. I returned, and next day but two had to go to Cleveland on duty. It has been impossible to put all the facts in shape before. Every day is precious, and we should, in my opinion, get this work under contract immediately, on account of getting materials to begin with this season, and for the general interest of the work.

T. J. CRAM.

Major Gen. A. A. HUMPHREYS,
Chief of Engineers, U. S. A.

B 7.—*Abstract of bids for furnishing materials and*

Number of bid.	Names of bidders.	Classification of materials to be furnished.				
		Class 1.	Class 2.	Class 3. Manufactured iron.		
		5,180 piles.	All sawed or hewed timber.	5,180 1-inch round, nut, and screw 2-washer bolts, 37,555 lbs.	7,124 bars 1-inch square iron for drift-bolts; 364,637 lbs.	18,668 spikes, 8 and 10 inches long and ¾-inch to ⅞-inch diameter.
		Pr. pile.	*Pr. M. b. m.*	*Per lb.*	*Per lb.*	*Per lb.*
1	H. M. Mixer, Monroe, Michigan	$6 25	$22 00	$0 09¼	$0 05	$0 07½
2	Joel W. Kelsey, Toledo, Ohio	4 48	....	....	....	....
3	Lond, Priest & Gay, Ausable, Michigan	6 50	25 00	....	....	....
4	Gilbert W. Ledlie, East Saginaw, Mich	....	....	9.9	5.9	7.9
5	Ledlie & Corse, Chicago, Ill	4 00	19 90	12	7¼	8¼
6	Harvey P. Platt, Toledo, Ohio	4 75	26 00	9	6¼	9
7	H. M. Loud, Detroit, Mich	6 50	Unintelligi	ble and not	in acc	ordance
8	D. E. Rice, Detroit, Mich	....	....	8¼	5¾	....
9	Walton & Fuller, Detroit, Mich	6 00	28 00	12½	7	8
10	Alexander McDonnell, Hamilton, C. W	4 50	22 00	each 1 15	6¼	9
11	Wm. Sanborn, Port Huron, Mich	5 00	24 00	....	....	....
12	John Brown, Thorold, C. W	3 20	19 00	7½	5	7
13	Brooks & Adams, Detroit, Mich	....	20 00	....	....	....
14	Buhl, Ducharme & Co., Detroit, Mich	....	....	9	5¾	7
15	Detroit Bridge and Iron Works	....	....	7¾	5¾	....
16	W. W. Williams & Smith, materials; and W. W. & E. T. Williams, work, Manlius, N. Y.	4 00	24 70	11	6	9
17	Eugene St. Amour, Detroit, Mich	6 00	....	....	....	....
18	Elias Sims, Cleveland, Ohio	4 00	....	....	....	....
19	R. A. Conolly, Chicago, Ill	4 20	22 00	13	8	12¼
20	Fox & Howard, Chicago, Ill	4 00	20 00 Piles only.	12½	8	9¼
21	Hasbrouck & Conro, Milwaukee, Wis	3 75	23 00	12	7½	10¾
22	Henry C. Kibbe, Detroit, Mich	3 80	....	....	....	....
23	J. M. Jones, Detroit, Mich	5 00	23 00	9	5¾	7½
24	Burt & Glasby, E. Saginaw, Mich	3 92	20 00	14	8	10
25	Farquhar McRae, Wallaceburg, C. W	3 88	....	....	....	....
26	Mason, Doty & Luce, Detroit, Mich	....	22 40	....	....	....
27	John Trowbridge & Bros., Detroit, Mich	6 16	22 00	....	....	....
28	John C. Valentine, E. Saginaw, Mich	....	19 00	....	....	....
29	L. M. Mason, Detroit, Mich	....	21 90	....	....	....
30	Seth P. Cushman, Detroit, Mich	3 25	....	....	....	....
31	A. A. McDonnell, Hamilton, C. W	5 60	....	....	....	....
32	George P. Sanborn, Milwaukee, Wis	3 50	24 00	14	7½	10
33	L. Reeve, E. Saginaw, Mich	....	20 95	....	....	....
34	E. Vanderbecke, Detroit, Mich	3 75	....	....	....	....
35	Ralphe C. Smith, Detroit, Mich	3 50	....	....	....	....
36	Milton H. Butler, Detroit, Mich	3 45	....	....	....	....

doing work at St. Clair flats, Michigan.

Classification of work to be done.

All the different kinds of work or labor here below have such dependence on each other that they must be put in one class of labor—class A.

Dredging per cubic yard, measured in the cut or bed; 653,280 yds.	Dredging per cubic yard, measured in the dikes or banks, 653,280 yds.	For preparing and driving the round piles.	For preparing and driving the sheet piles.	For framing and putting in per running foot of timber.								
				Binders, 4 in. by 6 in., 16,416 r. f.	Stringers, 5 in. by 6 in., 17,280 r. f.	Back caps, 8 in. by 8 in., 16,416 r. f.	F. water sill, 8 in. by 9 in., 17,280 r. f.	Cross-ties, 8 in. by 10 in., 90,930 r. f.	B. water sill, 6 in. by 12 in., 17,280 r. f.	R. siding and fenders, 8 in. by 12 in., 82,876 r. f.	Front siding, 10 in. by 12 in., 65,596 r. f.	Front caps, 12 in. by 12 in., 17,280 r. f.
$0 40	$0 45	*Pr. pile.* $3 00	*Pr. pile.* $1 00	$0 15 a	bove	water a	nd 20	c. under	water p	er lineal	foot.	
44	44	5 90	1 40	8	$0 08	$0 10	$0 16	$0 09	$0 16 {	Fenders, 16 c., r. siding, 10c.	} $0 11	$0 11
....	....	....	....	....	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	....	....	....	....	....
44	....	2 99	1 24	10	10	14	14	14	14	14	14	14
48¼	55¼	5 00	1 25	6	6½	7½	9	10½	10	12	15	16
with spe	cificatio	ns in ad	vertisem	ent.								
....	....	....	....	....	....	....	....	....	....	....	....	....
45	60	3 50	75	7	7	7	7	7	7	7	7	7
....	....	3 00	1 25	5	5	5	5	5	5	5	5	5
....	....	....	....	....	....	....	....	....	....	....	....	....
38	39	2 80	1 30	4¼	4¼	4¼	4¼	4¼	4¼	4¼	4¼	4¼
....	....	....	....	....	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	....	....	....	....	....
44	....	3 50	60	6	6	8	8	7	7	9	9	10
....	....	3 00	75	....	....	....	....	....	....	....	....	....
56	57	3 20	....	....	....	....	....	....	....	....	....	....
40	....	2 00	72	9	9	9	9	9	9	9	9	9
44½	44½	2 50	75	2½	3	6½	7½	8	7½	9½	12	14½
42	....	2 25	65	8½	8½	8½	8½	8½	8½	8½	8½	8½
50	....	....	....	....	....	....	....	....	....	....	....	....
50	....	2 90	....	....	6 p	er foot	above	and 12	per foot	below w	ater.	
44	....	1 40	81	8	8	8	8	8	6	8	8	8
....	....	....	....	....	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	....	....	....	....	....
....	....	4 20	....	....	....	....	....	....	....	....	....	....
34½	....	2 25	69	9½	9½	9½	9½	9½	9½	9½	9½	9½
....	....	....	....	....	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	....	....	....	....	....

Abstract of bids for furnishing materials and

Number of bid.	Names of bidders.	Cost of class 1—piles.	Cost of class 2—timber.	Cost of class 3.		
				Washer bolts.	Drift bolt iron.	Spikes, wrought iron.
1	*a* H. M. Mixer, Monroe, Michigan	$32, 375 00	$81, 054 11	$3, 567 72	$18, 231 85	$2, 353 43
2	Joel W. Kelsey, Toledo, Ohio	23, 206 40				
3	Loud, Priest and Gay, Ausable, Mich	33, 670 00	92, 106 95			
4	Gilbert W. Ledlie, East Saginaw					
5	*b* Ledlie & Corse, Chicago, Ill	20, 720 06	73, 317 13	4, 506 60	27, 347 77	1, 586 78
6	Harvey P. Platt, Toledo, Ohio	24, 605 00	95, 791 22	3, 379 95	23, 701 40	1, 680 12
7	H. M. Loud, Detroit, Mich					
8	D. E. Rice, Detroit, Mich			3, 192 17	19, 599 23	
9	*c* Walton & Fuller, Detroit, Mich	31, 080 00	103, 159 78	4, 695 37	25, 524 59	1, 493 44
10	Alexander McDonnell, Hamilton, C. W					
11	Wm. Sanborn, Port Huron, Mich					
12	*d* John Brown, Thorold, C. W	16, 576 00	70, 001 28	2, 816 62	18, 231 85	1, 306 76
13	Brooks & Adams, Detroit, Mich					
14	*e* Buhl, Ducharme & Co., Detroit, Mich			3, 379 95	18, 687 64	1, 306 76
15	*f* Detroit Bridge and Iron Works			2, 816 62	18, 687 64	
16	*g* W. W. Williams & Smith, materials; W. W. & E. T. Williams, work; Manlius, N. Y.	20, 720 00	91, 001 66	4, 131 05	21, 878 20	1, 680 12
17	Eugene St. Amour, Detroit, Mich					
18	Elias Sims, Cleveland, Ohio					
19	*h* R. A. Conolly, Chicago, Ill	21, 756 00	81, 054 11	4, 882 15	29, 170 96	2, 333 50
20	*i* Fox & Howard, Chicago, Ill	20, 720 00	73, 685 56	4, 694 37	29, 170 96	1, 773 46
21	*j* Hasbruck & Conro, Milwaukee, Wis	19, 425 00	Piles. 27, 158 40	4, 506 60	27, 347 77	1, 960 14
22	Henry C. Kibbe, Detroit, Mich					
23	J. M. Jones, Detroit, Mich					
24	*k* Burt & Glasby, E. Saginaw, Mich	20, 305 60	73, 685 56	5, 257 70	29, 170 96	1, 866 80
25	Farquhar McRae, Wallaceburg, C. W					
26	Mason, Doty & Luce, Detroit, Mich					
27	*l* John Trowbridge & Bros., Detroit, Mich					
28	*m* John C. Valentine, E. Saginaw, Mich					
29	L. M. Mason, Detroit, Mich					
30	Seth P. Cushman, Detroit, Mich					
31	A. A. McDonnell, Hamilton, C. W					
32	*n* George P. Sanborn, Milwaukee, Wis	18, 130 00	88, 422 67	5, 257 70	26, 436 18	1, 866 80
33	L. Reeve, E. Saginaw, Mich					
34	E. Vanderbecke, Detroit, Mich					
35	Balphe C. Smith, Detroit, Mich					
36	Milton H. Butler, Detroit, Mich					

a Bids for the whole or none; declines the award for iron.

b All material rehandled in dikes, 15 cents extra per yard. Bid for dredging not in accordance with adver

c Wants explanation of measurement in embankment. Explanation never been given. Bid for entirety or

d On examination of the original bid, it is discovered that a note accompanied the bid to the effect that as
the prices in his bid should be reduced as low as any other bidder. Hence the corrections in class 3. This is
separately.

e Declines the award on account of risk in sending kegs of spikes to a place where it would not be safe to

f Declines the award of bolts for the same reasons as above given by Buhl, Ducharme & Co.

g If the earth is measured in scows, deduct $2 per cubic yard. Bid for the whole or none. Too many con

h Bid for whole or none. Piles separate from the other work could not be driven for this price. Bid for the

i Bid for the whole or none.

j Bid for the whole or none; so understood at engineer's office, Detroit.

k Bid for driving not accepted on account of containing a condition. Bid for the whole or none. The piles

l Will only furnish 1,000 piles. This condition vitiates the bid for piles.

m All to be delivered in rafts. This condition vitiates the bid.

n In my first draft of abstract, I supposed this to be an honest bid from Sanborn himself, like other bids, and
of May 7, to the engineer department, I discovered that it was a "shyster" bid. Sanborn was a man of
21, (Hasbrouck & Conro.) I now reject the whole of this bid, No. 32, as a bid none but a trickster would palm
nying this abstract to the engineer department, June 11, 1867. I regret that such a bid should have disgraced

I certify this paper to be a correct abstract of the original bids.

doing work at St. Clair flats, Michigan—Continued.

Total cost of class 3.	Cost of class A.					Total cost of material.	Total cost of work.	Complete cost of the canal.
	Dredging, measured in cut.	Dredging, measured in dike.	Preparing and driving round piles.	Preparing and driving sheet piles.	Framing sawed timber.			
$23,153 00	$261,312 06	$293,976 00	$15,540 00	$16,400 00	$50,560 80	$136,582 11	$343,812 50	$480,394 61
....	287,443 20	287,443 20	30,562 00	22,960 00	36,491 34	....	....	....
....	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	....
33,441 15	287,443 20	....	15,488 20	20,336 20	46,441 72	127,478 28	369,709 12	497,187 40
28,761 47	316,840 80	....	25,900 00	20,500 00	38,719 53	149,157 69	401,960 33	551,118 02
....	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	....
31,712 40	293,976 00	391,968 00	18,130 00	12,300 00	23,894 78	165,952 18	348,300 78	514,252 96
....	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	....
22,355 23	248,246 40	254,779 20	14,504 00	21,320 00	16,215 47	108,932 51	300,285 87	409,218 38
....	....	....	....	....	....	....	....	....
23,374 35	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	....
27,689 39	287,443 20	....	18,130 00	9,840 00	27,382 62	139,411 05	342,795 82	482,206 87
....	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	....
36,386 61	261,312 00	....	10,360 00	11,808 00	30,721 86	139,196 72	314,201 86	453,398 58
35,638 79	290,709 60	290,709 60	12,950 00	12,300 00	30,069 38	130,044 35	346,028 98	476,063 33
33,814 51	274,377 60	....	11,655 00	10,660 00	29,015 09	....	325,697 69	....
....	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	....
36,295 46	287,443 20	....	7,252 00	13,284 00	27,308 32	131,286 62	335,287 52	466,574 14
....	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	....
33,560 68	225,381 60	....	11,655 00	11,316 00	32,428 63	140,113 35	280,781 23	420,894 58
....	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	....

tisement. But the bid is for the whole or none.
none.
he was not posted with the prices of iron and bolts and spikes in the States, he requested that for these articles
the lowest responsible accepted bid for the work, whether regarded as to be awarded in aggregate or by classes

keep them until taken off their hands by the government.

ditions in bid for dredging. No definite conclusion can be drawn except that the bid is higher than others.
driving unreasonable.

must be banded. This price, $1 40, conditional upon their not requiring to be banded with iron.

for the whole or none, and so received it. After sending off that preliminary abstract, accompanying letter
"straw" in the matter. The bid had been made out and signed with Sanborn's name by Conro, who bid No.
off on the government. The whole chain of facts connected with it are fully set forth in my letter accompa-
an abstract of mine. The bid, however, was understood at my office to have been for the whole or none.

T. J. CRAM, *Colonel of Engineers, Brevet Major General.*

B 8.

MILWAUKEE, *June* 19, 1867.

SIR: A letter or appeal to you, bearing date the ninth instant, a copy of which is annexed, was forwarded to you through General T. J. Cram. It has reference to letting of the government work upon the St. Clair flats, and will explain itself.

I now beg leave to enclose you, in connection therewith, my views, as aided by the advice of counsel, in answer to what I understand to be General Cram's views in the premises, and which I have reduced to writing, and also annexed hereto.

With great respect, your obedient servant,

GEORGE P. SANBORN.

Major General A. A. HUMPHREYS,
Chief of Engineers, U. S. Army, Washington, D. C.

An act of Congress of the United States entitled "An act making appropriation for the repair, preservation, and completion of certain public works heretofore commenced under authority of law, and for other purposes," approved March 2, 1867, made an appropriation in the words following, to wit:

"For improvement of St. Clair flats in Michigan, one hundred and fifty thousand dollars, to be expended in accordance with the plans and specifications of Colonel T. J. Cram, in his report of December tenth, eighteen hundred and sixty-six."

In and by the second section of this act it is provided, "That no contract shall be made, except after public advertisement for proposals in such form and manner as to secure general notice thereof, and the same shall only be made with the lowest responsible bidder therefor, upon security deemed sufficient in the judgment of the Secretary."

Section three of the act provides, "That whenever the Secretary of War shall invite proposals *for any works, or for any material or labor for any works*, there shall be separate proposals and separate contracts for each work, *and also for each class of material, or labor for each work*, and he shall report to Congress, on the first Monday of December next, all the bids with the names of the bidders."

The enclosed public advertisement, inviting sealed proposals for furnishing each class of materials and labor for the proposed improvement of the St. Clair flats, was given.

In pursuance with the said act of Congress, and the foregoing notice, I, George P. Sanborn, a resident of Milwaukee, Wisconsin, and a citizen of the United States of America, submitted my written and sealed proposals for furnishing each class of materials and labor separately.

John Brown, a resident of Thorold, Canada West, and a subject of Great Britain, in like manner submitted his proposals.

That upon opening such proposals so submitted, it was ascertained that my proposal or bid for the required dredging was $22,914 80 lower than any other, and that John Brown's bid was the lowest for the balance of the required work and materials; and that for the required materials and work, *as an entirety*, John Brown's was $11,679 73 lower than my combined bids for the work *as an entirety*.

The bids also show that by awarding the dredging to me under my bids therefor, and awarding to John Brown the balance of the materials and work to which he may be entitled as the lowest bidder under the act of Congress and said notice, that the cost of the entire work to the government would be

$22,864 80 less than the bid of John Brown for the required materials and labor as an entirety.

General T. J. Cram, notwithstanding the plain and explicit language of the third section of the act of Congress referred to, and its evident intent and spirit, and of his previous explicit construction thereof in his said notice, in which he says: "The act of Congress making the appropriation requires bids to be received and contracts made for *each class of materials, and for doing the work separately; and it may happen that he who gets the material may not get the contract for the work. The lowest responsible bid secures the contract.*"

Now he contends that John Brown, whose bid, though higher than mine for the dredging by nearly $23,000, but lower than any other for the work as an entirety, is still entitled to the contract for the whole; notwithstanding my lower bid for the dredging, which dredging of itself constitutes a very large and important portion of the entire proposed improvement, and will amount, as shown by the lowest bid therefor, to the sum of $225,381 60, while the entire proposed improvement, upon the lowest bid therefor, amounts, as an entirety, to but the sum of $409,627 55.

General Cram's expressed reasons for his "recent construction" of this act, (I mean by "recent" as contrasted with his previous construction, in his notice under which and the act of Congress bidders were guided in becoming competitors for the contracts,) as I understand them, are certainly very peculiar and unprecedented both in theory and practice, which, in a court of justice giving a judicial construction to the act, would hardly be regarded as equitable guides in getting at the intent of Congress.

Many of his expressed views, as I understand them, are in fact mere matters of possible expediency on the part of the government, or rather of convenience to its officers in superintending the work when performed under one contract, than when performed, as specified in the act of Congress, under more than one contract. For instance, it is claimed that the work is an entirety, and that the dikes or piers are composed in part by combination of the piles, timbers, and the earth dredged out of the channel, and that the combination of the different work to be performed in order to make a complete whole is so inseparably connected in its execution that it cannot be performed under distinct contract for its respective parts; and hence the further claim is founded on this specious argument that the dredging, the materials, and the work cannot be classed at all, and must therefore be let under one contract.

This line of argument virtually characterizes the act of Congress as an impracticable act, impossible of being carried out, and necessarily must claim that the work contemplated by it *can only be executed by disregarding its positive provisions in regard to the mode of its execution.* This result is unavoidable if General Cram's expressed views are tenable.

I claim that it is apparent from the act that Congress intended that the work should not be awarded merely to *jobbers in contracts*, and hence required a classification of the work and materials to enable the skilled mechanics of the country, and others, to compete for and participate in the performance of public work in the departments in which they are conversant.

To the entire species of argument made against my claim to this dredging contract in question, I urge—what was undoubtedly familiar to Congress when they framed and passed the act in question—that structures and improvements of every character, whether for private or public purposes, are the result of the combination of the different classes of skilled labor in connection with the combined use of the different class of materials adapted to the design, in the adaptation of which different class of materials the respective class of employed labor is skilled. So well is this understood by the government, as well as by private citizens, that in such structures engineers or architects prepare the specifications for each class of skilled labor, and the class of material used by each. Bids are taken separately by class, and contracts made accordingly; then, in order that the combination of the different classes of labor and material may produce the intended design, the contracts made with each class of contractors provide for and prescribe the duties of each.

The objections started by General Cram to the awarding the contract for the dredging to me in this instance are so novel and unexpected, and, according to my understanding of the act of Congress in question, are so unjust, that I felt aggrieved and compelled to appeal to General A. A. Humphreys, chief of engineers; and, accordingly, on the 13th day of June, 1867, I forwarded through General Cram my appeal, a copy of which is herewith given.

I do hereby respectfully beg to submit herewith, under the supervision of my counsel, my views in support of my rights under my bid for the dredging contract for the dredging to be done in the contemplated improvement of the St. Clair flats.

Respectfully yours,

GEORGE P. SANBORN.

MILWAUKEE, *June* 9, 1867.

DEAR SIR: On the 10th day of May I bid for the materials, labor, and dredging for the improvement of the St. Clair flats, under and in accordance with notice from T. J. Cram, inviting proposals for doing said work and furnishing said materials, a copy of which I hereby enclose. I was the lowest bidder for the dredging, and I suppose I am entitled to the contract under section three of the law making appropriations for the repairs, preservation, and completion of certain public works heretofore commenced under the authority of law, and for other purposes, approved March 2, 1867. I also think I am entitled to claim the dredging under General Cram's notice inviting proposals, as he has classified the work and materials to be furnished, and it will be noticed that he also stated in said advertisement for proposals that the above mentioned law requires bids to be received and contracts made for each class of materials, and for doing the work separately. I have applied to General Cram, by an agent, since the bids have been opened, and was informed by General Cram that he did not intend to separate the work if he could help it, but to give the contract for the whole work and materials to Mr. Brown, who is the lowest bidder, as an entirety. I am ready to give the required security for faithful performance of the contract for doing the dredging, and I am ready to take any other portion of the work in addition, or the whole, if it should fall to me.

The best part of the season for doing such work is passing away, and it is desirable to get at the work as soon as possible; therefore I should like to know at as early a day as is consistent if I am to have the contract.

I appeal this case direct to you, because, from the experience of the past few weeks, I do not see any hope of General Cram's forwarding my claim upon the merits under the law, as I understand it.

He insists that the contract for the entire contemplated improvement and materials must be embraced in one contract, which view is directly contrary to any understanding of the law and his notice, and as I am advised by my counsel, his construction of the act is contrary to its plain intent and meaning.

Very respectfully, your obedient servant,

GEORGE P. SANBORN.

Major General A. A. HUMPHREYS,
Chief of Engineers, United States Army.

To contractors.

OFFICE LAKE HARBOR IMPROVEMENTS,
No. 111 *Griswold Street, Detroit, Michigan.*

Written and sealed proposals for furnishing materials and doing the work will be received at this office, addressed to the undersigned, until the 10th day of April, 1867, for constructing a straight ship canal from the mouth of South Pass directly across the St. Clair flats, three hundred feet wide and thirteen feet deep below lowest stage of water, to be diked with piles and timber on each side for its whole length, to a height of five feet above water, and the earth dredged out from the canal to be put into the dikes and beyond them, so as to form the canal banks even in height with the dikes, and of uniform width on top, and having an outer slope going off into the lake water of two horizontal to one vertical. For further details of construction, bidders are informed that they must be in person at this office, where models, drawings, and specifications can be seen, and all explanation given.

MATERIALS REQUIRED.

1. Five thousand one hundred and eighty rock elm or white oak straight round piles, 12 inches at least, exclusive of bark, in diameter at the middle, and not less than 28 feet long.

2. Sixteen thousand four hundred sheet piles, 4 by 12, sawed, 18 feet long, white oak, rock elm, hard or white pine, that will drive well without splitting; widths may vary from 10 to 12 inches, giving an equivalent amount in board measure to what 12 inches in width would give for the total amount.

3. Eight hundred and sixty-four stringers, 5 by 6, sawed, 20 feet long, hard pine.

4. Eight hundred and sixty-four water-sills, 8 by 9, sawed, 20 feet long, hard or white pine.

5. Eight hundred and sixty-four water-sills, 6 by 12, sawed, 20 feet long, hard or white pine.

6. Eight hundred and sixty-four binders, 4 by 6, sawed, 19 feet long, hard or white pine.

7. Eight hundred and sixty-four fenders, 8 by 12, sawed, 20 feet long, white oak or hard pine.

8. Eight hundred and sixty-four front caps, 12 by 12, sawed, 20 feet long, heart of white oak or of hard pine.

9. Eight hundred and sixty-four back caps, 8 by 8, sawed, 19 feet long, hard or white pine.

10. One thousand six hundred and forty front sidings, 10 by 12, sawed, 20 feet long, hard or white pine.

11. One thousand eight hundred and twenty-two front sidings, 10 by 12, sawed, 18 feet long, hard or white pine.

12. One thousand six hundred and forty rear sidings, 8 by 12, sawed, 20 feet long, hard or white pine.

13. One thousand eight hundred and twenty-two rear sidings, 8 by 12, sawed, 18 feet long, hard or white pine.

14. Six thousand four hundred and ninety-five cross-ties, 8 by 10, sawed, 14 feet long, hard or white pine, or white oak.

The sawed stuff will amount to 3,684,278 feet board measure.

The round piles to be of best quality of timber; all the sawed stuff to be squarely and truly sawed to the dimensions stated, of good live timber, and to be free from rotten knobs, splits, shakes, or other defects tending to impair its durability or strength.

State the price of the bids of furnishing item 1, per pile delivered.

State the price in the bids per thousand feet, board measure, for furnishing all the sawed stuff delivered, the place of delivery being at the mouth of the South Pass, near "Jerry's ranch."

15. Two thousand five hundred and ninety 1-inch round iron nut and screw (and two washers) bolts, 27 inches long from outside of head to point of screw.

16. Two thousand five hundred and ninety ditto, 25 inches long from outside of head to point of screw.

NOTE.—These bolts may probably have to be varied from one-half to one inch in length, to suit variations in thickness of pile.

17. Six hundred and forty-eight bars 1-inch square iron, 12 feet long, for drift bolts, 25,754 pounds.

18. Six hundred and forty-eight bars 1-inch square iron, 14 feet long, for drift bolts, 30,046 pounds.

19. Five thousand eight hundred and twenty-eight bars 1-inch square iron, 16 feet long, for drift bolts, 308,837 pounds.

20. One thousand seven hundred and twenty-four pounds 10-inch wrought spikes, one-half inch in diameter.

21. Sixteen thousand nine hundred and forty-four pounds 8-inch wrought spikes, three-eighths inch in diameter.

The iron for the bolts and spikes to be of the best quality.

State the price per pound for furnishing and delivering items 15 and 16.

State the price per pound for furnishing and delivering items 17, 18, and 19.

State the price per pound for furnishing and delivering items 20 and 21, the place of delivery being the same as above stated.

One sixteenth part of each class of the twenty-one foregoing items to be delivered on or before the first of July next, and the remainder in instalments of one sixteenth for every month thereafter during navigation until all shall have been delivered.

Whoever receives the contract will be required to furnish two responsible indorsers in a bond of indemnity to the United States, to the amount of 20 per cent. of the total value of the materials contracted for.

State in the bids the names in full and residence of the bondsmen.

WORK TO BE DONE.

1. The average depth of water along where the canal is to be made was six feet two and a half inches last November, and nowhere less than three and a half feet, allowing scows to work with facility everywhere on and about the site.

The average thickness of the stratum or prism of earth to be excavated between the dikes is six feet nine and a half inches; the mean lift to raise it to the surface of the water is nine feet seven inches. The length of the canal is to be 8,200 feet. Borings show earth easy of dredging, and good for driving the piles. Should it be found hard to drive through the upper crust, dredging will be done along where the dikes are to stand to a sufficient depth to allow the piles to be driven to the depth of 24 feet below the surface of the water, for the round, and 17 feet for the sheet piles.

Earth to be dredged from between the dikes and put into the dikes, and into the canal banks beyond, so as to make them into proper shape as described, 618,280 cubic yards. Probable amount to be dredged to ease the driving of the piles, 35,000 cubic yards.

State the price per cubic yard, measured in the natural bed or cut, for so dredging and placing the earth. Also, state the price per cubic yard, measured in the dikes and banks, for so dredging and placing the earth.

2. State the price for preparing and driving the round piles per pile.
3. State the price for preparing and driving the sheet piles per pile.
4. State the prices for framing and putting in place according to plans and specifications, to be learned in this office, all the sawed timber per running foot of timber of each size, measured in the works, there being of 4 by 6, 16,416 running feet; of 5 by 6, 17,280 running feet; of 8 by 8, 16,416; of 8 by 9, 17,280; of 8 by 10, 90,930; of 6 by 12, 17,280; of 8 by 12, 82,876; of 10 by 12, 65,596; of 12 by 12, 17,280, mill measure—in all, 341,354 lineal feet.

The framing is exceedingly simple; all can be done with the adze, hand-saw, and auger. For every bolt to be driven a hole must be previously bored to a depth equal to the length of the bolt; a dovetail is to be cut on each end of the cross-ties, and corresponding notches in the embracing timbers. In the running timber-work the ends of the siding timbers are to abut, not lap, except the caps, fenders, and water-sills, which are to join by hewing. In each sheet-pile three spikes are to be driven without splitting, which will require previous boring.

It is highly desirable that one contractor should be fortunate in putting in his bids so as to secure to himself the contract for furnishing all materials and doing all the work. The doing of all the work, however, to be under one contractor, if the bids justify. The act of Congress making the appropriation requires bids to be received and contracts made for each class of materials and for doing the work separately, and it may happen that he who gets the material may not get the contract for the work. The lowest responsible bid secures the contract.

It is pertinent to remark, that from the beginning of the work at South Pass to the completion, all the machinery and work will be in almost all weather perfectly protected, nor will any hindrance arise from passing vessels or rafts, which, until the new channel shall be completed, will follow the old crooked route across the flats. These circumstances are of great consideration to the contractor.

The rule which has already been stated in reference to bondsmen and indemnity for materials, applies to the contract for doing the work.

Bidders will be particular to follow the instructions herein contained in writing out their proposals.

Time for completing the work, on or before the spring of 1869.

T. J. CRAM,
Col. Corps of Engineers, Brevet Maj. Gen. U. S. A.,
Superintendent of Harbor and River Improvements.

NOTE.—I claim that General Cram has made four classes of this work: First, dredging; second, driving round pile; third, driving sheet pile; fourth, framing and putting in place all sawed timber.

GEORGE P. SANBORN.

B 9.

MILWAUKEE, WISCONSIN, *June* 27, 1867.

SIR: Referring to my letter of the 19th instant, with which I enclosed to you my letter of appeal relating to the subject of my bids for public work upon the St. Clair flats, and the accompanying documents, suggesting argument in support of my appeal, I now beg leave to enclose to you copy of a series of interrogatories which have been propounded to me by General Cram, with my answers thereto appended, and a copy of my letter to General Cram, the originals of all of which were this day forwarded to him.

I ask that these may be considered in connection with my letter of appeal to you, dated June 9, instant, and accompanying document

Very respectfully, your obedient servant,

GEORGE P. SANBORN.

General A. A. HUMPHREYS,

Chief of Engineers, Washington, D. C.

MILWAUKEE, *June* 27, 1867.

SIR: The enclosed document contains copy of a series of interrogatories, propounded to me by Mr. E. Cram, upon the subject of my bid for, and the letting of, the government work upon, the St. Clair flats.

My answer is also appended to each one in its order.

The answers are submitted with entire respect and deference.

You will observe that in my letter on appeal to General A. A. Humphreys, dated June 9, instant, forwarded through you, I distinctly declare my willingness to accept contracts for all the classes of work awarded to me.

Very respectfully, your obedient servant,

GEORGE P. SANBORN.

Brevet Major General T. J. CRAM, *Detroit.*

JUNE 25, 1867.

SIR: In compliance with instructions of General T. J. Cram, colonel United States corps of engineers, I ask you the following questions:

Question 1. Will you withdraw your bid so far as relates to the dredging and driving the round and sheet piles in the contemplated construction of a straight ship canal across St. Clair flats, and refuse to take an award of contracts, unless the entire work is awarded to you?

Answer. No. I adhere to my claim to have awarded to me that portion of the work for which I was the lowest bidder.

Question 2. Will you, in case you decline to answer question one affirmatively, make an affidavit, stating whether your bid, in response to the advertisement of General T. J. Cram, colonel of engineers, published in the Detroit Advertiser and Tribune on the 29th March, 1867, inviting sealed proposals for constructing a straight ship canal across St. Clair flats, from the mouth of South Pass, was made by Conro, in your name, for the purpose of enabling the said Conro, of the firm of Hasbrouck & Conro, or of enabling the said Hasbrouck & Conro, to get, through an award to your said bid, the job or contract from you for the dredging, and for doing the other work, and for furnishing the materials, one or all of these jobs, in case Hasbrouck & Conro should fail to get these on their own bid; and that it was understood between Conro and yourself that you would transfer to him the jobs aforesaid, one or all, in case Hasbrouck & Conro should fail, and in case the bid in your name should succeed, in securing an award?

Please forward the affidavit in due form, if made, without delay, to Brevet Major General T. J. Cram, colonel United States corps of engineers, Detroit, Michigan.

Answer. I decline to make any statement under oath on the subject, until advised of some act of Congress, or some positive regulation from proper departments, requiring the same. I am willing to state the facts upon my honor, but I will not volunteer an extra-judicial oath. My counsel inform me that they have been unable to discover any act of Congress, and they are ignorant of any department regulation, requiring such an oath.

Supposing that any statement of facts contemplated by the second interrogatory would be useless, as not meeting your approval unless verified by affidavit, I have neglected to append any such, but will cheerfully do so, without oath, upon your suggestion, or under oath if required by any act of Congress or department regulation.

Question 3. In the event of your also declining to make the affidavit called for upon the points above explained in question two, will you then make an affidavit in due form, in your own terms, setting forth all the facts as you understand them, in relation to your said bid, and forward the same without delay to General Cram?

Answer. I decline making any affidavit for the reasons given in response to question two. I will make any statements of facts, in either form, as before suggested, if you will state more explicity what facts or circumstances you wish me to testify to. You say, alluding to a contemplated affidavit, "setting forth all the facts, as you understand them, in relation to your said bid." I cannot begin to conceive what range you would have me take in such statements. I had supposed that all material facts already appeared of record.

These questions are put to you in compliance with suggestions in a recent letter of instructions received by General Cram from the engineer department.

Very respectfully, yours,

E. CRAM, *Clerk.*

GEO. P. SANBORN, Esq., *Milwaukee, Wis.*

B 10.

ENGINEER DEPARTMENT,
Washington, June 18, 1867.

GENERAL: I have to acknowledge the receipt, on the 17th instant, of your communication of the 11th instant, containing a newly arranged abstract of proposals for the St. Clair flats improvement, with important information added, not contained in the abstract forwarded by you on the 7th May, and in which materials are distributed into classes in a manner altogether different from the classification used in the previous abstract.

The request for the return of the first abstract cannot be complied with, since it has formed the subject of action in the engineer department and by the Secretary of War, and has become part of the official records of the War Department and of the engineer bureau.

The classification adopted by you in the first abstract is correct, and conforms to the letter and spirit of the laws of 1866 and 1867. You there presented five classes of materials and four classes of labor or work.

The division of the three kinds of iron required into three subjects of contract is perfectly proper. The lowest bidders may, without assigning any reason, decline to contract, but the statement that there is any greater difficulty in the way of delivering one load of iron of one sort than there is in the delivery of three loads of three different sorts is unfounded, and forms no good reason for declining the award.

The advantage resulting from one person or firm having the contracts for all the material and all the labor are well understood here, but the law overrides all such considerations.

Congress having distinctly and unequivocally specified that the money appropriated shall be expended by contract, and by separate contracts for each class of material and for each class of labor, it remains simply to carry the law into effect.

In your communication of the 11th instant you state, "the law says no contract shall be made except after public advertisement for proposals, &c., and the same shall only be made for the work, [work meaning in this case ship canal; St. Clair flats,] with the lowest responsible bidder therefor," &c.

From what source was this quotation of the law made? The words "for the work" have no existence in the copies of the late laws furnished to the engineer department, or distributed from it.

The language of the law is explicit and positive. There can be no question as to its meaning; it admits of no discretion except when, from the nature of the work to be done, the same cannot, in the judgment of the Secretary, be made the subject of contract.

The Secretary has decided the question in the case of river and harbor works. They must be carried on by contract in the manner specified by law.

Further, articles of Army Regulations of 1863 are quoted by you as overriding the positive and specific requirements of laws passed in 1866 and 1867. It would seem to be needless to inform you that, in such cases, the law rules and cannot be qualified.

Prior to presenting the subject to the Secretary of War for his revision, it is deemed essential to have the written refusal of the bidders to enter into contracts for such portions of material or labor for which they may be the lowest, unless they shall have awarded to them the whole of the work of improvement or none.

It is also desirable that you ascertain *directly* from Mr. Sanborn, of Milwaukee, all of the facts of the case in relation to his bid for materials and labor, the assertions of Mr. Conro being ex parte, and hence inadmissible. Mr. Sanborn's affidavit to the facts of his bid being genuine and made in good faith should be required.

The contract may be awarded to Mr. John Brown for the entire work, when it shall appear that all the bidders lower than he is for such class of material and labor, as specified in your first abstract, shall have declined, in writing, the award to them for such classes of material and labor for which they are the lowest responsible bidders.

Conditions as to time in the execution of the contracts that will cause embarrassment and delays in the execution of the work of improvement will be carefully avoided.

Very respectfully, your obedient servant,

A. A. HUMPHREYS,
Chief of Engineers, Major General.

Brevet Major General T. J. CRAM, U. S. A.,
Colonel of Engineers, Detroit, Michigan.

B 11.

UNITED STATES ENGINEER OFFICE,
Detroit, July 3, 1867.

SIR: In reply to the suggestions and instructions in the engineer department letter to me of June 18, 1867, in relation to bids and awards for St. Clair flats, I have to report as follows:

It is assumed in the letter that I adopted a classification in my first abstract, sent to the department May 7th. This assumption is entirely contrary to the letter, spirit, and meaning of the author of that abstract.

In my final official abstract, sent with my letter June 11th, I made a classification by which I abide From the tenor of the letter one might infer that I had been judged as striving to get the work under contract in violation of law.

Nothing in my acts or correspondence can warrant such a reflection; on the contrary, that correspondence clearly evinces a determination to aid the engineer department to the end of having it to put under contract in strict accordance with law. I am asked from what source I quoted a portion of the laws. I answer, from the copy sent to me from the engineer department. Now, I see by inspection, the quotation was correct, but that I put one branch of the bracket in the wrong place. The following should have been the mode: "Provided that no contract shall be made except after public advertisement for proposals, &c., and the same [meaning contract] shall only be made with the lowest responsible bidder therefor." ("Therefor" meaning the work in this case, ship canal, St. Clair flats.) Comparing this, however, with the quotation in my letter of June 11th, and which has been questioned, one must see there is no difference in letter or spirit, not a shade even that can change the meaning, nor was it my intention to quibble.

In reply to "It is deemed essential to have the written refusal of the bidders to enter into contract for such portion of material or labor for which they may be the lowest, unless they shall have awarded to them the whole of the work of improvement," this suggestion has been complied with as far as possible. Sanborn (bid 32) refuses; "Hasbrouck & Conro," bid 21, could not be found by my clerk, who was sent to Milwaukee to see him and Sanborn. A week has been spent in sending him after the bidders; some were found; some he could not find; some would not say whether they would sign a refusal, but thought they must have time to think of it; wished not to say or do anything, provided by holding back they could get the whole reopened to be again advertised, &c. He discovered that this is the plan of the "ring" in which Conro is conspicuous, who is endeavoring, if he cannot get the job of dredging through Sanborn's bid, to prevent Brown from getting the award, and to have the work readvertised.

Papers No. 1, No. 2, No. 3, No. 4, No. 5, attached to this report, show, however, that John Brown, bid 12, H. M. Mixer, bid 1, W. W. & E. T. Williams, bid 16, Buhl, Ducharme & Co., bid 14, and Detroit Bridge and Iron Work Company, bid 15, have declined. There are some others that have not been reached on the subject; when their refusals are received I will forward them.

I come now to that part of said engineer department letter which says: "It is desirable that you ascertain directly from Mr. Sanborn, of Milwaukee, all the facts of the case in relation to his bid for materials and labor, &c. Mr. Sanborn's affidavit to the fact of his bid 32 being genuine and made in good faith should be required."

To carry out this suggestion I sent my clerk to Milwaukee, who saw and presented to Sanborn paper X, herewith embodied:

X.

STATE OF WISCONSIN, *County of Milwaukee, ss:*

George P. Sanborn, of the city of Milwaukee, in the State of Wisconsin, being duly sworn, deposes and says: That, in response to an advertisement of Brevet Major General T. J. Cram, colonel United States corps of engineers, published in the Detroit Advertiser and Tribune on the 29th of March, 1867, inviting sealed proposals for furnishing materials and doing the work for constructing a straight ship canal from the mouth of South Pass directly across St. Clair flats, I bid for furnishing the material and doing the work by a written proposal signed by one Conro in my own name; that the said bid was made for the purpose of enabling the said Conro, of the firm of Hasbrouck & Conro, to get, through an award to my said bid, the job or contract from me for the dredging and for the furnishing the materials and for doing the other work—one or all of these jobs—in case Hasbrouck & Conro should fail to get these on their own bid, and that it was understood between Conro and myself, before said bid in my name was put in, that I would transfer to him the jobs aforesaid, one or all, in case Hasbrouck & Conro's should fail, and in case the bid in my name should succeed to secure an award.

Which paper states the facts as I have understood them and now believe them to be—as told to me by Conro, and admitted to be by Conro's lawyer (Van Dyke) on his visit with Conro to me, claiming the award for Sanborn for Conro's benefit. Sanborn's expression was, "I presume Conro and General Cram understand the matter alike." Sanborn then refused to make affidavit to X. Then he was asked to make an affidavit that the bid was made in good faith for his own benefit, as expressed in paper Y. He refused to make affidavit to this.

Y.

STATE OF WISCONSIN, *County of Milwaukee, ss:*

George P. Sanborn, of the city of Milwaukee, in the State of Wisconsin, being duly sworn, deposes and says: That, in response to an advertisement of Brevet Major General T. J. Cram, colonel United States corps of engineers, published in the Detroit Advertiser and Tribune on the 29th of March, 1867, inviting sealed proposals for furnishing materials and doing the work for constructing a straight ship canal from the mouth of South Pass directly across St. Clair flats, I bid for furnishing the materials and for doing the work by a written proposal, signed by one Conro in my own name and by my authority, which authority was given by me to the said Conro in writing previous to his, the said Conro's, signing and handing in the said bid; that said bid was genuine and made in good faith and in my own interest alone, and was not made, in whole or in part thereof, in the interest of the said Conro, or in the interest of Hasbrouck & Conro, of Milwaukee, Wisconsin, or of either of them; that I authorized the said Conro to make out the said bid as to prices for materials and for labor before the said bid was put in; that the aforesaid bid was for the whole of the materials and for the whole work advertised for, or for none of the materials or work, and it was so meant by me before said bid was put in or opened; that I have not answered this bid for the benefit of the said Conro or Hasbrouck & Conro since the same was put in and since it became publicly known, nor have I assumed the bid since it became publicly known for the purpose of turning the benefit of an award of a contract to me upon it either in part or in whole of what was bid for over the said Conro or Hasbrouck & Conro; and that the copy of said bid hereto annexed is, to the best of my belief, true.

The following quotation was then put to Sanborn: "Will you, then, make an affidavit in due form in your own terms, setting forth all the facts, as you understand them, in relation to your said bid, and forward the same without delay to General Cram?" His answer was: "I decline making any affidavit."

All of which is respectfully submitted to accompany my remarks upon the appeal of George P. Sanborn to the Chief of Engineers, which appeal is marked B.

Very respectfully, your obedient servant,

T. J. CRAM,
Colonel Corps Engineers, Brevet Major General.

Major Gen. A. A. HUMPHREYS,
Chief of Engineers.

No. 1.

BAY CITY, MICHIGAN, *June* 25, 1867.

GENERAL CRAM: As I bid for the entirety of St. Clair flats improvement, and knowing that the successful completion of the plan, though in its parts very simple and in its whole easy to construct if all be made under one contractor, and all of us, as I understood the matter, having bid for the whole or none, and knowing from my long experience that two or more contractors on such a job would inevitably clash, I hereby decline to contract for parts of the work, unless I am awarded the whole, as being the lowest responsible bidder for the whole material and work. But I am ready at any time to accept the award of the whole upon my bid as put in with its accompanying note, if the engineer please, in relation to iron bolts and spikes.

Respectfully yours,

JOHN BROWN.

I certify the above to be a true copy of John Brown's original letter declining to contract for parts of his bids, but expressing his willingness to contract for all his bid.

T. J. CRAM,
Colonel Engineers, Brevet Major General.

No. 2.

MONROE, *June* 14, 1867.

DEAR SIR: I desire to withdraw my proposal to furnish materials for the construction of a ship canal across the St. Clair flats.

Very respectfully, yours, &c.,

H. M. MIXER.

Maj. Gen. T. J. CRAM,
Detroit, Michigan.

I certify that the above is a true copy of the original.

T. J. CRAM,
Brevet Major General, Colonel Corps Engineers.

No. 3.

DETROIT, *June* 24, 1867.

We, the undersigned, W. W & E. T. Williams, who bid for doing the work on St Clair flats canal, according to items in General Cram's advertisement of 29th March, 1867, decline taking the work simply for driving sheet piles at 60 cents each, as our bid contemplated all the work or none.

W. W. & E. T. WILLIAMS.

General CRAM,
United States Engineer.

I certify that the above is a true copy of the original.

T. J. CRAM,
Brevet Major General, Colonel Corps Engineers.

No. 4.

DETROIT, *June* 28, 1867.

We, the undersigned, decline the award of contract for furnishing nut and screw and washer bolts for 9 cents per pound, also for iron bars for drift-bolts at 5½ cents per pound, also spikes for 7 cents per pound, delivered at South Pass mouth, for the St. Clair ship canal, near where was "Jerry's ranch."

BUHL, DUCHARME & CO.

General T. J. CRAM,
Detroit, Michigan.

I certify that the above is a true copy of the original.

T. J. CRAM,
Brevet Major General, Colonel Corps Engineers.

No. 5.

DETROIT, MICHIGAN, *July* 3, 1867.

DEAR SIR: We herewith withdraw proposition of April 10, 1867, to furnish bolts, nuts, and washers for St. Clair flats ship canal improvement.

Respectfully yours,
DETROIT BRIDGE AND IRON WORKS,
By WM. C. CALHOUN, *Secretary.*

General T. J. CRAM,
Superintendent of H. R. Improvement.

I certify that the above is a true copy of the original.

T. J. CRAM,
Brevet Major General, Colonel Corps Engineers.

B 12.

UNITED STATES ENGINEER OFFICE, *July* 5, 1867.

SIR: In reply to your letter of the 25th ultimo, transmitting to me certain copies of letter of appeal, June 9th, to the Chief Engineer, and of the agreement to sustain the appeal (drawn out by Conro's lawyer) purporting to be from George P. Sanborn, Milwaukee, claiming the award of dredging for St. Clair flats ship canal, I have the honor to submit the accompanying papers, marked A, containing my abstract of bids 21, 32, and 12, with copies of original bids attached and the remarks thereon, and my advertisement, B, containing the letter of appeal to Chief of Engineers and agreements to sustain it, purporting to be from George P. Sanborn, but in reality from lawyer Van Dyke, Conro's attorney, pushing for an award to Sanborn's bid for the benefit of Conro; C, containing my report and declinatures from bidders received in accordance with suggestions in engineer department letter to me 18th June, 1867, and the following remarks, in which reference is occasionally and necessarily made to contents of A, B, and C.

I. As to awarding the dredging to George P. Sanborn, of Milwaukee, (bid No. 32,) see abstract herewith sent of bids 12, 21 and 32, and certified copies of the original bids attached.

In relation to this bid 32 I have to remark, some days after sending my letter of May 7th, with the abstract of bids for items not classified, to the engineer department, I discovered that this bid 32 was a fraud, which had I known when

I opened the bids, I would have rejected in toto, and it should never have appeared on an abstract of mine. The evidence of this piece of sharp practice became conclusive some days afterwards.

Conro, who in the name of Hasbrouck & Conro bid No. 21, drew up bid 32, signed Sanborn's name and put it in, not for Sanborn to get the contract, but for Hasbrouck & Conro to get the dredging, provided their bid No. 21 should fail to be the lowest. It turns out that Sanborn was a "straw" used by Conro to obtain for Hasbrouck & Conro the advantage of two bids to each of their fellow-bidders, having one which was unbeknown until since that abstract and my letter of 7th May were sent. I find that Sanborn used to be a book-keeper to Conro, and is now a broker in small business, and knows no more about constructions than the most inexperienced. On opening the bids I mistook him for another Sanborn. Conro has since twice acknowledged perpetrating the trick, and that he did it to secure to himself the dredging in case Hasbrouck & Conro's bid No. 21 should fail to secure the whole.

There never has been a word, verbally or in writing, from Sanborn to me, claiming the contract or acknowledging the bid, or conferring any authority for Conro to use his (Sanborn's) name in the matter, which makes bid 32 without such written authority tantamount to a forgery. I stamp this straw bid No. 32 as a transaction worthy of a trickster.

Conro first, on seeing that Brown for the entirety was the lowest, went and proposed to Brown to take him (Conro) in as a partner on Brown's bid; Brown's reply was that the contract had not been awarded, consequently he could give no definite reply to such a proposition. Conro has since been active to secure for himself the dredging on the fraudulent bid in name of Sanborn, and Conro's pertinacity shows a desire more for a hand upon the public crib than for the interest of this important public work. I regard his use of a straw bidder as an unfair attempt to overreach those who put in their bids honestly.

Conro has had the barefacedness a third time to call on me, the last time with a lawyer, (the same who now makes appeal to the Chief Engineer ostensibly for Sanborn.) This lawyer is behind the scenes pushing Sanborn, the straw bidder, forward, but really in the interest of Conro, and wrote out the appeal to the Chief of Engineers in Sanborn's name, claiming that the dredging should be awarded to Sanborn, to the end that he (Conro) may get the contract through Sanborn.

It is needless to say I have treated this claim of Conro's with silence, and in making up my final abstract, which was sent to the department June 11, I marked upon the abstract a rejection of the whole bid No. 32, for reasons herein stated and thereon assigned under the head of remarks.

Sanborn has never written a word to me—made any claim upon me in writing or by any authorized agents upon the subject. He has thought proper, by his counsel, only to communicate directly with the Chief Engineer upon the claim for the award.

The reasons and facts above stated are in my estimation sufficient for the Secretary of War to reject the bid 32 in Sanborn's name.

But there is another reason, not before mentioned, that bid 32 for dredging should be rejected in comparison with others for the reason that in his bid for dredging he does not conform to the advertisement in an essential point. (See his original bid for dredging.) He does not propose for the dredging which is to be measured after being put in the dikes and banks, as will be seen by the copy of his bids.

The following extracts from my advertisement will prove this defect:

(*a*) "Earth to be dredged from between the dikes and put into the dikes and canal banks beyond, so as to make them the proper shape as described. * *

"State the price per cubic yard, measured in the natural bed or cut, for so dredging and placing the earth. Also state the price per cubic yard, measured in the dikes and banks, for so dredging and placing the earth"

The defect, an essential one, in the bid is apparent. On the ground of this non-compliance with my advertisement I reject bid No. 32 for the dredging. If awarded to him upon the price for that only to be measured in the cut, what price is to be paid for that part, or the whole of what in the construction I shall find it necessary to measure in the dikes and banks? The advertisement and the plan of carrying on the work show that some may have to be measured one way and some the other.

Nor has any authority been presented to me, verbally or in writing, giving me the least reason to hope, much less to believe, that the persons named in bid 32 as bondsmen will consent to sign a bond for Sanborn.

II. In relation to argument B to sustain Sanborn's appeal, Sanborn's lawyer copies section one of the act correctly, but in his argument he gives the go-by to the practical interpretation of that section, not deigning a word upon it except to quote it. I will endeavor to elucidate the clause which says "to be expended in accordance with the plans and specifications of Colonel T. J. Cram in his report of December 10, 1866." That plan is set forth in the report, and contemplated beginning the work at the mouth of South Pass, and carrying on the wood and iron work of both dikes, the dredging to fill the dikes, and to form the banks and to make the water-way all simultaneously, thus pushing endwise by short sections at a time through the whole line of the work, completing the whole, section by section, as we progress.

And this I submit is an essential and important feature of section one, in the plan of execution; and this is the proper mode of engineering the work, and practically implies *one* contractor for all the different kinds of labor involved in carrying out the plan. To separate the labor into kinds or items, and award so as to have several contractors, would greatly embarrass the work. They would inevitably clash. Common sense runs counter to such a mode of awards, which, if made a precedent, will be the means of leading to inextricable involvements, as will be seen further on.

I hold that all the different kinds of labor for this should constitute one class, which I have characterized by A in my final abstract, forwarded June 11, 1867.

The lawyer positively perverts the second section of the act in skipping essential features and quoting what suits his client—virtually ignoring other portions of the section. I here supply the ignored parts, which any one can see for himself by reading the section through:

(*b*) "*And provided,* That * * * the money appropriated by this act shall be so applied as to complete or make the nearest approximation to completing *the work* for which each specific appropriation is made."

(*c*) "*Provided,* That no contract shall be made except after public advertisement, * * * and the *same* shall only be made with the lowest responsible bidder *therefor* upon security," &c.

The word "same" refers to "contract" and the word "therefor" refers to "the work" expressed in second proviso. This is the plain common-sense English of the law.

The first part, *b*, omitted by him, but now supplied, will settle the question against the lawyer, even supposing Sanborn's bid not ruled out in toto, or in part, for the dredging, for it will be seen in passage *c* that John Brown (bid No. 12) declines to take an award for part or parts, but will take the bid, modified by his note, for $409,218 38, or at his bid, excluding the note, * * for $411,627 55. The last paragraph but two of my advertisement reads:

(*d*) "It is highly desirable that one contractor should put in his bids so as to secure to himself the contract for furnishing all materials and doing all the work. The doing of all work, however, to be under one contractor, if his bids justify."

All the bidders for the entirety responded to the first part of *d*, and put in their bids expecting to be awarded the whole or none; and hence it was so remarked on my final official abstract. None but Conro (bid 21) and Sanborn (bid 32) have as yet shown the meanness to repudiate that understanding. They come forward after the bids are made public to claim awards for any kind or item they bid for or the whole they bid for. Now, suppose (what I do not believe will be the case) that my ruling, rejecting bid 32 in toto or rejecting the part for dredging, be overruled by the Secretary of War, and the award for dredging made to Sanborn. In such an event we have to look to some other bid than John Brown's (bid 12) for all materials and all work other than dredging. The next lowest to Brown's bid for the materials (of those whom we have any evidence will accept partial awards) is bid No. 32—this same Sanborn's—amounting to $140,113 35. The next lowest bid to Brown's for all work other than dredging (of those whom we have any evidence will accept partial awards) is bid No. 21 (Hasbrouck & Conro's—the same Conro who is at the bottom of the appeal) amounting to $51,330 09. Bid 32 (Sanborn) for dredging amounts to $225,481 60. Total cost of the work, $416,825 04.

But John Brown, who bid for the entirety, will still hold to his bid, and accept the award of the whole, at $409,218 38. Difference in favor of the United States if given to Brown, $7,606 66.

I here ask the sapient lawyer which award would fulfil the law quoted and marked *b*? and which award will fulfil the meaning of quotation *c*, requiring the contract to be made only with the lowest responsible bidder (not bidders) therefor?

Further comment is unnecessary to convince that if the dredging be awarded to Sanborn we must, as a consequence, award all the materials to him, and, as another consequence, all the work other than dredging to Hasbrouck & Conro, and thus would the letter and spirit of the law be violated; on the contrary, by awarding the whole to Brown, the letter and spirit meaning of the law would be fulfilled.

III. Further in relation to the argument of Sanborn's lawyer to sustain the appeal. He quotes section third of the act: (*e*) "There shall be separate proposals, and separate contracts for each work, and also for each class of material or labor for each work," and upon this goes into much special pleading to convince the Chief of Engineers that the law requires the award to be given to Sanborn. Nothing more clearly shows a brain muddled with the greediness for government contracts than this special pleading, full of speciousness and rank sophistry. He conducts his argument by assuming that "separate contracts" necessarily means separate contractors, and holds that we are bound by the law to award in a manner implying a separate contractor for each kind or item of labor or material. This is one part of his foundation, which I think is no better than sand, at all events. I differ essentially from his construction, and will briefly show the fallacy of such an idea. In this work there are not less than seventeen different items or kinds of material and labor. To admit a contractor for each, therefore, implies eighty-five copies of articles of agreement, thirty-four bonds to be written out, duly signed and acknowledged, fifty-one bondsmen, and seventeen contractors. This small army of contractors would be in each other's way, each claiming to do his item of work, be paid for it, and to be quit of his job without regard to the work of the other sixteen. Nothing satisfactory can be accomplished in this way, and no responsible contractor would undertake a bid under so diluted a division, in two kinds, of material or labor; such is the practical tendency of admitting his construction. I do not infer "separate contracts" to mean there shall be separate contractors for each item, or even "kind" or even "class," of material or labor.

I apprehend the meaning to be that it is one duty in drawing up articles of agreement to specify therein separate classes of labor or material, and to the end that kinds, quantities, (r,) by weight or measure, and prices shall be clearly designated therein; and this separation in the articles of agreement is tantamount to "separate contracts," all being legally permitted in the same instrument and under one contractor. If I am decided to be lame in this point of my construction by supervising authority, then (*e*) of the 3d section comes in direct conflict with (*c*) of the 2d section of the act. In such an ambiguous conflict, to what shall we resort as a precedent? I answer, to previous practice, which has been that in the many articles of agreement I have made on behalf of the United States in reference to the works named in the act to which sections two and three belong, in the past two years, I have done precisely in accordance with my views as above stated, and contrawise to the construction of Sanborn's lawyer; every one of which articles of agreement (and several of which contain "separate contracts") has been approved by the proper authority.

To depart from this practice (which I hold is strictly in accordance with the law) now because this lawyer has come into the arena, and make contracts upon his sophistication of section three, and to allow ourselves to be blinded by the cloud of dust he has raised to the nullification of the provisions of section two, (which he skipped,) would, I respectfully submit, lead us into many difficulties, besides the palpable violation of the law.

Another important difference between this lawyer and myself is this: He assumes in his argument to sustain the appeal that "class of material" and "class of labor" mean in practical engineering the same as "kinds or items of material," and "kinds or items of labor." I deny that, from the English language or the practice of the engineer any such assumption is admissible as applicable to the work in question.

What does "class of material" mean in this connection? It is interpreted by experienced engineers and contractors of constructions as meaning *things placed together which have something in common and a necessary practical connection*. And what does "class of labor" mean? It means those kinds of labor which have something in common practical connection, and which cannot be separated without injury and risk in the execution of the work of improvement. To say that "items" or "kinds" constitute classes in the meaning of the law is begging the whole question at issue. To award to separate contractors "kinds" or "items" is endangering the whole structure and practically nullifying the act of Congress, as I have already shown. The lawyer in his argument insinuates that in "said notice" (meaning my advertisement) I classified material and labor. A similar idea is also held out in the engineer department letter to me of June 18, that I classified labor and material in my abstract sent May 7. I here respectfully but emphatically deny having made a classification either in my advertisement or in that abstract. I did, however, make a classification in my final official abstract sent with my letter of June 11, just as shown on the abstract A, herewith sent. I hold that this shows the proper practical engineering classification in connection with the work in question. In my letter before to the engineer department upon "classes" and "kinds" or "items" I have said enough to show, without repetition here, that such as I have made should be the classification if we classify at all.

Whose business is it to classify? Congress has not classified the labor or material. The engineer department has not, nor has the Secretary of War. Is it the province or right of a particular bidder (who has never been a contractor) seeking an award upon a "shyster" bid to make the classification?

I submit that the engineer in charge can with propriety, until instructed by higher authority to the contrary, classify legally not only labor but material. In accordance with this right I classified as shown on my abstract of June 11, and to this right we must hold if we expect successfully to prosecute the work.

I have denied classifying in my advertisement. I only numbered items in it with the numerals 1, 2, 3, 4, &c. To call this a classification is an assumption not warranted, and only resorted to by a special pleader, to raise a mist behind which to conceal the weakness of his cause.

The numbering of the items in the advertisement was to guide the bidders in the manner of putting down their prices as far as possible in a uniform manner, and to facilitate computations of the bids in my office, and nothing else, as had been the practice for other works. If the numbering in the advertisement is to be wrested into a classification and used as a pretext by the lawyer for subserving the particular interests of the man who put in spurious bid 32, what is to become of the rights of the other 35 bidders? Would they not have a right in equity to a reconsideration of the whole matter? And this would lead to the blotting out all we have done and pricking anew by readvertising, and thus another retardation of the work for another season, to the money detriment to commerce of another half million of dollars.

The interpretation which in the foregoing remark I have given to the sections 1, 2, 3, are the same I had the honor to present to the engineer department in my letters of June 1st and 3d, in relation to Erie and Grand River harbors, and of June 11th, in respect to St. Clair flats; and it was upon the same interpretation of sections 1, 2, 3, all considered fairly in their relations to each other, that I thought it my duty to recommend, as I did in my letter of May 7th, the award of the entirety of the St. Clair flats work to John Brown, who *was* and *is* the lowest responsible bidder therefor.

Since perplexing questions, however, (in respect to Erie, Grand River, St. Clair flats and Ausable,) have been turned back upon me, I have thought it advisable to consult the highest authority within my district for an interpretation of the law.

I have obtained the opinion, and must respectfully insist upon its forming a part of this paper in answer to Mr. Sanborn's appeal.

The opinion speaks for itself, and here follows:

UNITED STATES DISTRICT ATTORNEY'S OFFICE,
EASTERN DISTRICT OF MICHIGAN,
Detroit, June 26, 1867.

GENERAL: I have to acknowledge your communication of June 25th, requesting my opinion as to the construction of the act of Congress approved March 2, 1867, entitled "An act making appropriations for the repair, preservation, and completion of certain public works heretofore commenced under the authority of law, and for other purposes," Sess. L, 1867, p. 418, with reference to certain practical questions which present themselves.

It is a cardinal rule that in the construction of statutes, each section is to be interpreted with reference to the other sections and the law as a whole.

I first observe that the appropriation for St. Clair flats improvement is to be expended in accordance with your plans and specification by section 1, and that by section 2 the money voted is to be made to go as far as possible towards finishing the work, and that by the *same section* the honorable Secretary of War is to expend the money by *contract,* (except in cases of examinations and surveys.) In regard to the aforementioned matters the law is clear.

Section 2 further provides that the work *shall be let to the lowest responsible bidder therefor.* This means clearly, in my opinion, to the lowest single individual, partnership, or company who shall put in a bid for the entire public improvement; the word "*therefor*" signifying *the public work advertised to be contracted for.*

In the light of this latter portion of section 2, the language of *section* 3, were it otherwise ambiguous, (which I think it is not,) becomes plain.

There shall be separate proposals and *contracts for each work* and EACH CLASS OF MATERIAL OR LABOR for each work.

I think this is by no means to be interpreted as requiring a *separate individual contractor* for each class. It evidently means that each *single bidder shall classify and itemize his bid.*

This provision is made, undoubtedly, for two reasons: first, because the work is to be done according to certain plans; and second, to prevent the frauds sometimes resulting from a *lumping* bid.

Any other construction than that which I give I apprehend would nullify the appropriation; for it would be impossible, in the first place, to find persons who would contract for portions of the work; and secondly, if the former objection is met, such persons would inevitably disagree and clash, so as to delay or destroy the work.

But I regard *sec.* 2 as IMPERATIVE in requiring that the whole work should be let to ONE contractor.

Permit me to express the opinion that the early letting and completion of this work is very highly desirable for the interest of our commerce.

Very respectfully, your obedient servant,

ALFRED RUSSELL,
United States District Attorney.

Brevet Major General T. J. CRAM,
Colonel of Engineers, Detroit.

I certify that the foregoing is a true copy of the original letter in every word, point, single line and double line of underscoring.

T. J. CRAM,
Brevet Major General, Colonel Engineers.

Since receiving this official opinion, in an interview with Hon. J. M. Howard' one of our most eminent lawyers, and who helped to make the law, he gave precisely the same interpretation, corresponding with my own previous interpretation, also with Mr. Russell.

I remark upon the fling at Brown in B. Conro's lawyer's argument signed with Sanborn's name, because of Brown's residing in Canada, that this unmanly shaft is thrust with an ill grace, since "Hasbrouck & Conro" have had their residence for many months, if not years, and one still lives, in Canada. Brown was for three years the able, faithful, and efficient contractor for the United States at Fort Niagara. Because he hails from Canada now, I required him to present bondsmen who should be citizens of the United States, with which he promptly complied.

There is much besides what I have remarked upon in this paper in the letter of appeal and the argument B full of gammon, to which I have made marginal notes, which may be seen by any one wishing to follow out his arguments.

To sum up, we are forced to the following conclusion:

1. That Sanborn was not a *bona fide* bidder, as will be proven by what I have heretofore reported, and in his refusal to make affidavits or to give any satisfactory answer in relation to bid 32. (See my report C.)

2. That I did my duty in rejecting bid 32 *in toto*, (as soon as I found out the deceit,) which Sanborn has (subsequently to the opening of the bids) been put forward to claim an award upon, for the benefit of Conro.

3. Whether the bid be allowed to stand rejected *in toto* at the War Department or not, the part for the dredging must be rejected.

4. That therefore Brown's bid 12 is the lowest responsible bid for the work, and even for the item of dredging.

5. That Brown is entitled to the awards for the entirety on bid 12 (whether

all or the dredging alone of bid 32 be rejected or not rejected by the Secretary of War) by all that is fair, and by the complete and full opinion of the United States district attorney.

In conclusion, I have to request that this paper, with the accompanying papers, may be laid before the honorable Secretary of War as early as possible, for a decision of the question as to whom the contract or contracts shall be awarded.

I have the honor to be, very respectfully, your obedient servant,

T. J. CRAM,
Colonel of Engineers, Brevet Major General.

Major General A. A. HUMPHREYS,
Chief of Engineers, U. S. A.

B 13.—*Abstract of bids for furnishing material and*

Number of bid.	Name of bidder.	Classification of materials to be furnished.				
		Class 1.	Class 2.	Class 3. Manufactured iron.		
		5,180 piles.	All sawed or hewed timber and lumber.	5,180 1-inch round, nut, and screw 2-washer bolts, 37,555 pounds.	7,124 bars 1-inch sq. iron for drift bolts; 364,637 pounds.	18,668 pounds spikes 8 and 10 inches long, ½ and ⅝-inch in diameter.
		Pr. pile.	*Pr. M. b. m.* Piles only.	*Per. lb.*	*Per lb.*	*Per lb.*
21	Hasbrouck & Conro, Milwaukee, Wis	$3 75	$23 00	$0 12	$0 7¼	$0 10¼
32	George P. Sanborn, Milwaukee, Wis	3 50	24 00	14	7½	10
12	John Brown, Thorold, C. W	3 20	19 00	11 7½	5½ 5	8 7

Abstract of bids for furnishing material and

Number of bid.	Name of bidder.	Cost of Class 1.	Cost of Class 2.	Class 3.			Total cost of Class 3.
				Nuts and screw washer bolts, iron.	Drift-bolt iron.	Spikes, wrought iron.	
			Piles.				
21	*a* Hasbrouck & Conro, Milwaukee, Wisconsin.	$19,425 00	$27,158 40	$4,506 60	$27,347 77	$1,960 14	$33,814 51
32	*b* George P. Sanborn, Milwaukee, Wisconsin.	18,130 00	88,429 67	5,257 70	26,436 18	1,866 80	33,560 68
12	*c* John Brown, Thorold, C.W.	16,576 00	70,001 28	4,131 05 2,816 62	19,143 44 18,231 85	1,493 44 1,306 76	24,767 93 22,355 23

a Bid for whole or none—so understood at the engineer office, Detroit.

b In my first draught of abstract, I supposed this to be an honest bid from Sanborn himself, like other bids, and
ter, May 7, to the engineer's department, I discovered that it was a shyster bid. Sanborn was a man of straw
brouck & Conro.) I now reject the whole of this bid, No. 32, as a bid none but a trickster would palm off
ng this abstract to the engineer department, June 11, 1867. I regret that such a bid should disgrace an abstract
Additional remarks since my abstracts of May 7 and June 11 : I now reject the bid for dredging because of

c On a re-examination of the original bid it is discovered that a note accompanied the bid to the effect that
articles the prices in his bid should be reduced as low as any other bidder; hence the corrections in Class 3.
by classes separately.

This abstract, as far as bids 21, 32, and 12 are concerned, is precisely like that sent May 7, 1867, excepting
June 11, after I discovered the fraud in bid 32.

In my abstract sent May 7 there was no classification either of material, or work, or labor; things to be bid
Nor was there any classification in my advertisement. The classification I knew could be made in drawing
been the practice in my office in numerous contracts I had before made, and all sanctioned in the department.

doing work at St. Clair flats, Michigan.

Classification of work to be done.

All the different kinds of work or labor here below have such dependence on each other that they must be put in one class of labor—Class A.

Dredging per cubic yard measured in the cut or bed; 653,280 yards.	Dredging per cubic yard measured in the dikes or banks; 653,280 yards.	For preparing and driving the round piles.	For preparing and driving the sheet piles.	For framing and putting in per running foot of timber.								
				Binders, 4 in. by 6 in., 16,416 r. f.	Stringers, 5 in. by 6 in., 17,280 r. f.	Back caps, 8 in. by 8 in., 16,416 r. f.	F. water sill, 8 in. by 9 in., 17,280 r. f.	Cross ties, 8 in. by 10 in., 90,930 r. f.	B. water sill, 8 in by 12 in., 17,280 r. f.	R. siding and fenders, 8 in. by 12 in., 82,876 r. f.	Front siding, 10 in. by 12 in., 65,596 r. f.	Front caps, 12 in. by 12 in., 17,280 r. f.
		Pr. pile.	*Pr. pile.*									
$0 42	....	$2 25	$0 65	$0 8½	$0 8½	$0 8½	$0 8½	$0 8½	$0 8½	$0 8½	$0 8½	$0 8½
31½	....	2 25	69	9½	9½	9½	9½	9½	9½	9½	9½	9½
38	$0 39	2 80	1 30	4½	4½	4½	4½	4½	4½	4½	4½	4½

doing work at St. Clair flats, Michigan—Continued.

Cost of Class A.					Total cost of all material.	Total cost of all labor or work.	Complete cost of the canal.
Dredging measured in cut.	Dredging measured in dikes.	Preparing and driving round piles.	Preparing and driving sheet piles.	Framing sawed timber.			
$274,377 60	....	$11,655 00	$10,660 00	$29,015 09	....	$325,697 69	....
225,381 60	....	11,655 00	11,316 00	32,428 63	$140,113 35	280,781 23	$420,891 58
248,246 40	$254,779 20	14,504 00	21,320 00	16,215 47	111,341 68 108,932 51	300,285 87	411,627 55 409,218 38

for the whole or none, and so received it. After sending off that preliminary abstract and accompanying let-
in the matter. The bid had been made out and signed with Sanborn's name by Conro, who bid No. 21, (Has-
upon the government. The whole chain of facts connected with it are fully set forth in my letter accompany-
of mine. The bid, however, was understood at my office to have been for the whole or none. .
non-compliance in an essential feature with my advertisement to which this bid was in response.
as he was not posted with the prices of iron, and bolts, and spikes in the States, he requested that for these
This is the lowest responsible accepted bid for the work, whether regarded as to be awarded in aggregate or

the parts seen in this in red ink and the remarks, and this is like the one I sent as my final official abstract

or were numbered in items for more convenience in bidding intelligently and for computing costs in my office.
up the contract to meet the conditions prescribed in section three of the law, as had, for the last two years,
Not a word of objection had, to my knowledge, been raised there until the question of St. Clair flats came up.

T. J. CRAM, *Colonel Engineers.*

Copy of original bid No. 21.

General T. J. CRAM,
United States Engineer, Detroit, Michigan:

We propose to furnish materials, and do the work, to construct the straight-cut canal across the St. Clair flats, according to the plans now on file in your office, as follows:

Rock elm or white oak piles, each	$3 75
White oak, rock elm, or soft pine, sheet piles, board measure	23 00
One-inch round screw-bolts, per pound	12
Square iron, for drift-bolts	07½
Eight and ten-inch wrought spikes	10½
Preparing and driving round piles, each	2 25
Preparing and driving sheet piles, each	65
Framing and putting in place the sawed timber of all sizes, per running foot	08½
Dredging for dikes, the earth to be measured in the excavation, per cubic yard	42
Dredging between the dikes and placing the earth in the canal banks and the dikes, and measured in the excavation	42

HASBROUCK & CONRO,
Milwaukee, Wisconsin.

A. E. GOODRICH, *Chicago,*
M. B. MILBURY, *Milwaukee,*
Bondsmen.

I certify the above to be a true copy of the original bid.

T. J. CRAM,
Colonel of Engineers, Brevet Major General.

Copy of original bid No. 32.

General T. J. CRAM,
United States Engineers, &c.:

I propose to furnish all materials and do the work for constructing the canal from the mouth of South Pass across the St. Clair flats, 300 feet wide, and the required depth, to be diked with piles and timber on both sides, in accordance with plans and specifications now on file at your office and advertisement, as follows:

Round piles, each	$3 50
Sawed lumber and sheet piles, per M, board measure	24 00
Round piles driven, each	2 25
Sheet piles driven, each	69
Screw-bolts, per pound	14
Inch square drift-bolts	07½
Spikes, per pound	10
Framing and placing timber, per lineal foot	09½
Dredging, measured in excavation, per cubic yard	34½

GEORGE P. SANBORN, *Milwaukee.*

JOHN J. DETON, *of Milwaukee,*
O. J. HALL, *of Milwaukee,*
for Bondsmen.

I certify this to be a true copy of the bid 32, which was written out by Conro and signed by Conro with Sanborn's name.

T. J. CRAM,
Colonel of Engineers, Brevet Major General.

Copy of original bid No. 12.

DETROIT, *April* 10, 1867.

SIR: I propose to furnish all the material and to do all the work, according to the advertisement for constructing a straight ship canal from the mouth of South Pass directly across the St. Clair flats, 300 feet wide by 13 feet deep, at the following rates:

MATERIAL.

Round piles, each	$3 50
Sheet piling, stringers, water sills, binders, caps, sidings, and cross-ties, per M, board measure	19 00
Round iron bolts, nuts, screws, and washers	11
Square iron ditto, per pound	05¼
Spike, wrought iron, per pound	08

WORK.

Earth to be dredged from between the dikes and put into the dikes and into the canal banks beyond, measured in natural bed or cut	38
Measured in the dikes or banks, for so dredging and placing the earth, per cubic yard	39
Preparing and driving piles, each	2 80
Preparing and driving sheet piles, each	1 30
Framing and putting in place all the sawed timber, per lineal foot	04¾

This bid is put in, paying duties on piles; if no duties, thirty cents less than in my bid.

In case the front piling should be required to be driven battring, fifty cents per running foot extra.

JOHN BROWN.

Sureties:
E. TROWBRIDGE & HENDRY, *Detroit.*

T. J. CRAM, Esq.,
Col. Corps of Engineers, Brevet Maj. Gen. U. S. A.,
Sup't Harbor and River Improvements.

NOTE.—The figures in red, under the head "complete cost," show what Brown's total bid would amount to, at prices 7½ cents, 5 cents, and 7 cents per pound for nut and screw bolts, iron, and spikes, such as Brown proposed in a note accompanying this bid, and referred to in my letter of 11th June to engineer department, and which note has since been disallowed by the department.

T. J. CRAM.

This is a true copy of the original bid.

T. J. CRAM,
Col. Corps Engineers, Brevet Major General.

DETROIT, *May* 2, 1867.

DEAR SIR: Not being fully posted in price of iron and bolts, I will say that, if I am fortunate enough to have the whole contract awarded to me, I will furnish those articles at as low a figure as any bid you may receive.

My object in making this offer is that I may control the whole work, and then there could be no difficulty between contractors.

JOHN BROWN.

General T. J. CRAM.

I certify the above to be a true copy of the original note accompanying Brown's original bid. None of these bids were opened, owing to my absence, until the 5th of May, and in the hurry of recording so many bids, this note escaped observation until after my abstract of 7th May was sent off. If this note be accepted, Brown's bid will be less, as shown by the red figures in the abstract herewith sent.

T. J. CRAM,
Col. Engineers, Brevet Major General.

To contractors.

OFFICE LAKE HABOR IMPROVEMENTS,
No. 111 *Griswold street, Detroit, Michigan.*

Written and sealed proposals for furnishing materials and doing the work will be received at this office, addressed to the undersigned, until the 10th day of April, 1867, for constructing a straight ship canal from the mouth of South Pass directly across the St. Clair flats, 300 feet wide and 13 feet deep, below lowest stage of water; to be diked with piles and timber on each side, for its whole length, to a height of five feet above water, and the earth dredged out to form the canal to be put into the dikes and beyond them, so as to form the canal banks even in height with the dikes, and of uniform width on top, and having an outer slope going off into the lake water of two horizontal to one vertical.

For further details of construction, bidders are informed that they must be in person at this office, where models, drawings, and specifications can be seen, and all explanations given.

MATERIALS REQUIRED.

1. 5,180 rock elm or white oak straight round piles, 12 inches, at least, exclusive of bark, in diameter at the middle, and not less than 28 feet long.
2. 16,400 sheet piles, 4 by 12, sawed, 18 feet long, white oak, rock elm, hard or white pine, that will drive well without splitting; widths may vary from 10 to 12 inches, giving an equivalent amount, in board measure, to what 12 inches in width would give for the total amount.
3. 864 stringers, 5 by 6, sawed, 20 feet long, hard pine.
4. 864 water sills, 8 by 9, sawed, 20 feet long, hard or white pine.
5. 864 water sills, 6 by 12, sawed, 20 feet long, hard or white pine.
6. 864 binders, 4 by 6, sawed, 19 feet long, hard or white pine.
7. 864 fenders, 8 by 12, sawed, 20 feet long, white oak or hard pine.
8. 864 front caps, 12 by 12, sawed, 20 feet long, heart of white oak or of hard pine.
9. 864 back caps, 8 by 8, sawed, 19 feet long, hard or white pine.
10. 1,640 front sidings, 10 by 12, sawed, 20 feet long, hard or white pine.
11. 1,822 front sidings, 10 by 12, sawed, 18 feet long, hard or white pine.
12. 1,640 rear sidings, 8 by 12, sawed, 20 feet long, hard or white pine.
13. 1,822 rear sidings, 8 by 12, sawed, 18 feet long, hard or white pine.
14. 6,495 cross-ties, 8 by 10, sawed, 14 feet long, hard or white pine or white oak.

The sawed stuff will amount to 3,684,278 feet, board measure. The round piles to be of best quality of timber; all the sawed stuff to be squarely and truly sawed to the dimensions stated, of good live timber, and to be free from rotten knots, splits, shakes, or other defects tending to impair its durability or strength.

State the price in the bids of furnishing item 1, per pile, delivered.

State the price in the bids, per thousand feet, board measure, for furnishing all the sawed stuff delivered, the place of delivery being at the mouth of the South Pass, near Jerry's ranch.

15. 2,590 1-inch round-iron nut and screw (and 2 washers) bolts, 27 inches long from outside of head to point of screw.

16. 2,590 1-inch round-iron nut and screw (and 2 washers) bolts, 25 inches long from outside of head to point of screw.

NOTE.—These bolts may probably have to be varied from ½ to 1 inch in length to suit variations in thickness of pile.

17. 648 bars 1-inch square iron, 12 feet long, for drift-bolts, 25,754 pounds.

18. 648 bars 1-inch square iron, 14 feet long, for drift-bolts, 30,046 pounds.

19. 5,828 bars 1-inch square iron, 16 feet long, for drift-bolts, 308,837 pounds.

20. 1,724 pounds 10-inch wrought spikes, ½ inch in diameter.

21. 16,944 pounds 8-inch wrought spikes, ⅜ inch in diameter.

The rim for the bolts and spikes to be of the best quality.

State the price per pound for furnishing and delivering items 15 and 16.

State the price per pound for furnishing and delivering items 17, 18, and 19.

State the price per pound for furnishing and delivering items 20 and 21.

The place of delivery being the same as above stated.

One-sixteenth part of each class of the twenty-one foregoing items to be delivered on or before the 1st of July next, and the remainder in instalments of one-sixteenth for every month thereafter during navigation until all shall have been delivered.

Whoever receives the contract will be required to furnish two responsible indorsers in a bond of indemnity to the United States to the amount of 20 per cent. of the total value of the materials contracted for.

State in the bids the names in full and residence of the bondsmen.

WORK TO BE DONE.

1. The average depth of water all along where the canal is to be made was six feet two and a half inches, last November, and nowhere less than three and a half feet, allowing scows to work with facility everywhere on and about the site.

The average thickness of stratum, or prism of earth, to be excavated between the dikes is 6 feet 9½ inches; the mean lift to raise it to the surface of the water is 9 feet 7 inches. The length of the canal is to be 8,200 feet. Borings show earth easy of dredging and good for driving the piles; should it be found hard to drive through the upper crust, dredging will be done along where the dikes are to stand, to a sufficient depth to allow the piles to be driven to the depth of 24 feet below the surface of the water for the round, and 17 feet for the sheet piles.

Earth to be dredged from between the dikes and put into the dikes, and into the canal banks beyond, so as to make them into proper shape as described, 618,280 cubic yards; probable amount to be dredged to ease the driving of the piles, 35,000 cubic yards.

State the price per cubic yard, measured in the natural bed or cut, for so dredging and placing the earth.

Also state the price per cubic yard, measured in the dikes and banks, for so dredging and placing the earth.

2. State the price for preparing and driving the round piles, per pile.

3. State the price for preparing and driving the sheet piles, per pile.

4. State the prices for framing and putting in place, according to plans and specifications, to be learned in this office, all the sawed timber, per running foot of timber of each size, measured in the works, there being of 4 by 6 16,416 running feet; of 5 by 6, 17,280 running feet; of 8 by 8, 16,416; of 8 by 9, 17,286; of 8 by 10, 90,930; of 6 by 12, 17,286; of 8 by 12, 82,876; of 10 by 12, 65,596; of 12 by 12, 17,280, mill measure—in all, 341,354 lineal feet.

The framing is exceedingly simple; all can be done with the adze, handsaw, and auger. For every bolt to be driven a hole must be previously bored to a depth equal to the length of the bolt. A dovetail is to be cut on each end of the cross-ties, and corresponding notches in the embracing timbers. In the running timber-work the ends of the siding timbers are to abut, not lap, except the caps, fenders, and water-sills, which are to join by halving. In each sheet-pile three spikes are to be driven without splitting, which will require previous boring.

It is highly desirable that one contractor should be fortunate in putting in his bids so as to secure to himself the contract for furnishing all the materials and doing all the work. The doing of all work, however, to be under one contractor, if bids justify. The act of Congress making the appropriation requires bids to be received and contracts made for each class of materials and for doing the work, separately, and it may happen that he who gets the material may not get the contract for the work. The lowest responsible bid secures the contract.

It is pertinent to remark that from the beginning of the work at South Pass to the completion, all the machinery and work will be in almost all weather perfectly protected, nor will any hindrance arise from passing vessels or rafts, which, until the new channel shall be completed, will follow the old crooked route across the flats. These circumstances are of great consideration to the contractor.

The rule which has already been stated in reference to bondsmen and indemnity for materials, applies to the contract for doing the work. Bidders will be particular to follow the instructions herein contained in writing out their proposals. Time for completing the work, on or before the spring of 1869.

T. J. CRAM,
Colonel Corps of Engineers, Brevet Major General U. S. Army,
Superintendent Harbor and River Improvements.

B 14.

UNITED STATES ENGINEER OFFICE,
Detroit, Michigan, August, 1867.

SIR: I herewith forward the abstract of bids upon the St. Clair flats improvement, as the result of the new advertising for proposals, in obedience to your letter of instructions to me of July 16, 1867. You will perceive that the classifications in the advertisement and abstract correspond with the classifications made in your instructions, your "first class," "second class," "third class," under the head of materials, being designated by the letters B, C, D. Inasmuch as your instructions divide the work to be done under the head of "labor" into two classes, first and second, which I have designated by E and F, it became necessary, for the security of the dikes while in progress of construction, to introduce another class, which I have designated by A. This is contingent, and will be necessary upon class F being assigned to another contractor than him to whom E might be awarded. Item 5 under class E is, of course, contingent upon the same event. It would not be wise to be unprovided with the means of staying and securing the wood-work of the dikes, as we should have to do under separate contractors for E and F, who would inevitably, in spite of all the precautions we can take to make them work in harmony, sometimes clash, as their interests would be affected.

There is another point to be explained: As near as I can foresee, the contingent dredging item 1, class E, also dredging class F, will, for the interest of the work, have to be measured, say, one-half in natural bed and one-half in banks and dikes; hence, in making up the costs, add one-half the price bid measured in natural bed to half the price bid measured in banks and dikes, and multiply the mean thus obtained by the number of yards, and we obtain the cost of E and F. It is upon this principle that the sums in columns headed "Total cost of class E" and "Cost of class F," marked in the abstract with a red star, have been computed to ascertain who is the lowest bidder for each class, E and F.

For the entirety, the lowest bid is seen to be No. 5, John Brown, $397,125 68.

Of those who have put in their bids according to instructions in the advertisement, the lowest bidders for separate classes are—

For class A, bid No. 3, Fox & Howard	$750 00
For class B, bid No. 5, John Brown	14, 504 00
For class C, bid No. 9, J. S. Miner	58, 027 28
For class D, bid No. 10, Moses Hill	20, 502 46
For class E, bid No. 3, Fox & Howard	64, 393 32
For class F, bid No. 5, John Brown	224, 126 50
Total cost by having six contractors	382, 303 56

In regard to bidders and their bondsmen, named in the bids—

For class A, bid No. 3, I know nothing of their means or pecuniary responsibility.

For class B, bid No. 5, bidder perfectly good in means and pecuniary responsibility; also the bondsmen.

For class C, bid No. 9, bidder doubtful as to efficiency and pecuniary responsibility; bondsmen considered good in so far as pecuniary responsibility is concerned.

For class D, bid No. 10, considered to be good in means and pecuniary responsibility.

For class E, bid No. 3, I know nothing of the bidders' means or pecuniary responsibility, nor of the responsibility or pecuniary means of the bondsmen.

For class F, bid No. 5, bidder and bondsmen considered good in means of machinery to carry out the work; also in pecuniary responsibility.

It will be seen at the foot of the abstract that another bid (seen in red ink) for the entirety was put in. I have forwarded the calculations of this bid. This bid I would reject for its non-conformity to the advertisement. The non-conformity was, I think, purposely done. On the 6th day of August I wrote to the bidder to the effect that he must write me at once whether this bid was intended for the whole or none, or whether he would accept, if awarded to him, any class designated A, B, C, D, E, F, upon which he bid. He replied by telegraph that he would write. At least eight mails have since come from Chicago, but no letter upon the subject. I have no confidence in him or his bondsmen, and do not believe he would accept of class F without having other classes, which are very high, assigned to him, in order to make up for the loss on F at his prices. It will be perceived his bid for the entirety is $406,371 12. I submit the bid, however, for rejection by the United States, or for acceptance, as the higher authority may elect. If the award is made for the entirety to the lowest responsible bidder, who bid according to the advertisement, (bid No. 5,) the approximate cost of the work will be $31,628 32, (*a*,) less than my original estimate. But if the awards be made to the lowest bidder for classes as above described, (rejecting the bid in red,) the approximate cost is less by $36,450 44, (*b*,) than my original estimate, and we should have the disadvantage of several contractors. Difference between (*a*) and (*b*) is only $4,822 12, not enough to balance the advantage to be gained by having one responsible contractor for the entire work, and as the second section of the act making the appropriation directs that the contract for each work shall only be made with the lowest responsible bidder, therefore I can see no reason why this advantage should not be made available to this work. See accompanying opinion of United States district attorney for eastern district of Michigan.

In conclusion I would remark that in case awards should be made by classes, it would be well if authority be given to contract with the next lowest responsible bidder and so on, should any who are the lowest in the abstract fail to accept, as I now think one or two would. In the advertisement the right of rejecting all or any of the bids is reserved to the United States as directed.

Very respectfully, your obedient servant,

T. J. CRAM,
Colonel of Engineers, Brevet Major General.

Major General A. A. HUMPHREYS,
Chief of Engineers United States Army.

UNITED STATES DISTRICT ATTORNEY'S OFFICE,
EASTERN DISTRICT OF MICHIGAN,
Detroit, June 26, 1867.

GENERAL: I have to acknowledge your communication of June 25, requesting my opinion as to the construction of act of Congress approved March 2, 1867, entitled "An act making appropriations for the repair, preservation, and completion of certain public works heretofore commenced under the authority of law, and for other purposes," (Sess. L. 1867, p. 418,) with reference to certain practical questions which present themselves.

It is a cardinal rule that in the construction of statutes each section is to be interpreted with reference to the other sections and the law as a whole.

I first observe that the appropriation for St. Clair flats improvement is to be expended in accordance with your plans and specifications by section 1, and that by section 2 the money voted is to be made to go as far as possible towards finishing the work, and that by the same section the honorable Secretary of War is to expend the money by contract, (except in case of examinations and surveys.) In regard to the aforementioned matters the law is clear.

Section 2 further provides that the work *shall be let to the lowest responsible bidder therefor.* This means clearly, in my opinion, to the lowest single individual, partnership, or company who shall put in a bid for the entire public improvement; the word "*therefor*" signifying *the public work advertised to be contracted for.*

In the light of this latter portion of section 2, the language of section 3, were it otherwise ambiguous, (which I think it is not,) becomes plain. *There shall be separate proposals* and *contracts for each work* and EACH CLASS OF MATERIAL OR LABOR for each work.

I think this is by no means to be interpreted as requiring a *separate individual contractor* for each class. It evidently merely means that each *single bidder shall classify and itemize his bid.*

This provision is made undoubtedly for two reasons: 1. Because the work is to be done according to certain plans; and, 2. To prevent the frauds sometimes resulting from a *lumping bid.*

Any other construction than that which I give I apprehend would nullify the appropriation; for it would be impossible, in the first place, to find persons who would contract for portions of the work; and, secondly, if the former objection is met, such persons would inevitably disagree and clash, so as to delay or destroy the work.

But I regard section 2 as IMPERATIVE in requiring the whole work should be let to ONE contractor.

Permit me to express the opinion that the early letting and completion of this work is very highly desirable for the interest of our commerce.

Very respectfully, your obedient servant,

ALFRED RUSSELL,
United States District Attorney.

Brevet Major General T. J. CRAM,
Colonel of Engineers, Detroit.

I certify that the above is a true copy of the original letter.

T. J. CRAM,
Colonel Engineers, Brevet Major General.

B 15.

To contractors.

OFFICE LAKE, HARBOR AND RIVER IMPROVEMENTS,
No. 111 *Griswold street, Detroit, Mich.*

All proposals heretofore made for St. Clair flats are rejected, and new written and sealed proposals for purchasing material and doing the work will be received at this office, addressed in duplicate to the undersigned, until the 5th August, 1867, for constructing a *straight ship canal* from mouth of South Pass directly across St. Clair flats, three hundred feet wide and thirteen feet deep, below lowest stage of water, to be diked with piles, timber, and earth on each side for its whole length (about one and a half mile) to a height of five feet above water. The filling for the dikes and the rest of the canal banks to be done with the material to be dredged out from between the dikes to form the canal waterway; and the material to be put into the dikes and beyond and contiguous to them, so as to form the canal banks even in height with the dikes, and of uniform width on top, and having an outer slope-off into the lake water of two horizontal to one vertical.

For further and minute details of construction bidders must call in person at this office, where models, drawings, and specifications can be seen, and will be explained between the hours of noon and 1 p. m.

Materials to be furnished.

CLASS A.

Item 1.—(Contingent and may not be required.)—15,000 running feet, 6 to 10 inches diameter, round, straight, small timber or poles, in sticks of various lengths, not less than 20 feet, however.

CLASS B.

Item 1.—5,180 rock elm or white oak, straight, round piles, 12 inches diameter at least, exclusive of bark, at the middle, and not less than 28 feet long, of best quality of timber, straight and otherwise good for driving.

CLASS C.

Item 1.—16,400 sheet piles, 4 by 12, sawed, 18 feet long, white oak, rock elm, hard or white pine, that will drive well without splitting; width may vary from 10 to 12 inches, giving an equivalent amount in board measure to what 12 inches in width would give to the total amount.

Item 2.—864 stringers, 5 by 6, sawed, 20 feet long, hard pine.

Item 3.—864 water-sills, 8 by 9, sawed, 20 feet long, hard or white pine.

Item 4.—864 water-sills, 6 by 12, sawed, 20 feet long, hard or white pine.

Item 5.—864 binders, 4 by 6, sawed, 19 feet long, hard or white pine.

Item 6.—864 fenders, 8 by 12, sawed, 20 feet long, white oak or hard pine.

Item 7.—864 front caps, 12 by 12, sawed, 20 feet long, heart of white oak or of hard pine.

Item 8.—864 back caps, 8 by 8, sawed, 19 feet long, hard or white pine.

Item 9.—1,640 front sidings, 10 by 12, sawed, 20 feet long, hard or white pine.

Item 10.—1,822 front sidings, 10 by 12, sawed, 18 feet long, hard or white pine.

Item 11.—1,640 rear sidings, 8 by 12, sawed, 20 feet long, hard or white pine.

Item 12.—1,822 rear sidings, 8 by 12, sawed, 18 feet long, hard or white pine.

Item 13.—6,495 cross-ties, 8 by 10, sawed, 14 feet long, hard or white pine, or white oak.

The sawed stuff will amount to 3,684,278 feet, board measure, and all to be squarely and truly sawed to the dimensions stated, of good, live timber, and to be free from rotten knots, splits, shakes, or other defects tending to impair its durability or strength.

CLASS D.

Manufactured iron.

Item 1.—2,590 1-inch iron nut and screw (and two washers) bolts, 27 inches long from outside of head to point of screw. 2,590 1-inch iron nut and screw (and two washers) bolts, 25 inches long from outside of head to point of screw. (NOTE.—These bolts may probably have to be varied from one-half to one inch in length, to suit variations in thickness of piles.)

Item 2.—648 bars one-inch-square iron, 12 feet long, for drift-bolts—25,754 pounds; 648 bars one-inch-square iron, 14 feet long, for drift-bolts—30,046 pounds; 5,582 bars one-inch square iron, 16 feet long, for drift-bolts—308,837 pounds.

Item 3.—1,724 pounds 10-inch wrought spikes, ½-inch in diameter; 16,914 pounds 8-inch wrought spikes, ⅜-inch in diameter.

The iron for the bolts and spikes to be of the best quality.

Labor or work to be done.

CLASS E.

Item 1.—(Contingent and may not be required.)—Dredging, say 35,000 cubic yards, to ease the driving of the piles, if the engineer should find it necessary, and putting the same into the canal banks, to be measured either in bank or in the natural bed before being dredged, at the option of the engineer in charge.

Item 2.—Preparing and driving the round piles, so that these points shall be 24 feet below said lowest stage of water, and to be in line, and without damage to the heads of piles such as to prevent them from being well shouldered and faced to receive the watersills or other timbers to be connected with the piles, according to plans. Borings have shown the earth to be good for driving and holding the piles.

Item 3.—Preparing, driving, and spiking sheet piles, so that their points shall be 17 feet below said stage of water, and joined so closely to each other that the earth filled into the dikes will not wash through the joints, and be bored where spiked to the side timbers, and heads not to be split in the driving so as to injure them.

Item 4.—Framing, fitting, putting in place, boring, fastening together and into piles by spikes and bolts, including cutting the bars into bolts; all sawed timber or lumber, (besides sheet piles,) of which there will be about 341,354 running feet of various sizes, (as seen in items 1 to 13, class C.) Where bolts, whether nut and screw or drift, are inserted, boring must be previously done for the whole depth of wood the bolts are to penetrate. For the fenders and binders, the round washers, heads, and nuts of the screw bolts must be countersunk into the timbers; the side pieces and cross-ties to be framed together, with the double dovetail joint.

Item 5.—Framing, fitting, putting in place, and fastening all small round timbers or poles, if needed, according to the judgment of the engineer, say about 15,000 running feet. This is contingent, and may not be required. It must, however, be bid for.

CLASS F.

Item 1.—Dredging between the dikes, so as to make the prescribed canal water-way, and putting the earth dredged into the dikes and banks, so as to make them of the shape described, namely, about 58 feet uniform width on top, including the width of the dikes; 5 feet high above water, and outer slope off into the lake water two feet horizontal to one vertical. The approximate amount to be dredged for these purposes is about 618,280 cubic yards; the amount so to be dredged and so to be placed to be measured either in natural bed before dredging, or in the dikes and banks after they are made into shape, at the option of the engineer in charge. No distinction must be made by the bidder as to "soft" or "hard." Borings have shown the earth to be easy for dredging, but the bidder takes all risk on the character of the earth.

One-sixteenth part of the items of each class of material to be delivered, if required, by the engineer in charge, on or before the 1st of September next, and the remainder in instalments of one-sixteenth for every month thereafter during navigation, if required, until all shall have been delivered that may be required to complete the work, which it is expected will be completed, should appropriations continue to be made, on or before the close of navigation in 1869.

The dredging and formation of the banks to commence simultaneously, and to keep pace with, and to be subordinate to, the construction of the wood-work of the dikes, with at least two dredges of power to raise 600 cubic yards per day each, and as many additional dredges are afterwards to be put into the work as the engineer may require to push the construction with safety and economy.

It is highly desirable that a bidder for the entirety should be so fortunate in putting in his prices as to be the lowest, or as low as any for each class.

The right of rejecting all bids, or any of them, is reserved to the United States.

Bidders are notified that the contractor for class E will be required to receive at the site of the improvement, or at some convenient point in that vicinity, all materials of wood and iron used in the work, in such quantities and at such times as the engineer in charge of the improvement may direct, and will be responsible for the safe-keeping of the same.

The place of deposit for materials will be near where was "Jerry's ranch;" and bidders are informed that there is no dock, no house or inhabitant within seven miles of the site of the work, except the light-house.

Bidders will please conform to the following form in writing out their bids, and forward *in duplicates*, filling the blanks with prices and attaching a copy of this advertisement to the bid:

The undersigned proposes to furnish for St. Clair flats improvement—

CLASS A.—Item 1, for —— cents per running foot.

CLASS B.—Item 1, for —— dollars per mile.

CLASS C.—Items 1 to 13 inclusive, for —— dollars per thousand feet, board measure.

CLASS D.—Item 1, for —— cents per pound; item 2, for —— cents per pound; item 3, for —— cents per pound, and to do the work.

CLASS E.—Item 1, for —— cents per cubic yard, measured in natural bed; for —— cents per cubic yard, measured in dikes and banks of the canal; item 2, for —— dollars per pile; item 3, for —— dollars per pile; item 4, for —— cents per running foot; item 5, for —— cents per running foot.

CLASS F.—Item 1, for —— cents per cubic yard, measured in the natural bed; for —— cents per cubic yard, measured in dikes and banks of the canal.

—— ——, *Bidder.*
—— ——,
—— ——,
Bondsmen.

General T. J. CRAM,
United States Engineer Officer in charge.

The bidder will please write his name in full, in a legible hand; also, his residence; and his two bondsmen must sign their names below his, stating their residence, and be citizens of the United States.

Each bidder must state in his proposal whether he wishes the award of the whole he bids for or none. Bids for items in a class, without covering all the items therein, not acceptable.

The amounts stated in the foregoing items subject to be varied as the engineer in charge may find necessary.

T. J. CRAM,
Colonel Corps Engineers, Brevet Major General.

B 16.—*Abstract of bids for furnishing materials and*

Number of bid.	Name of bidder.	Classifi
		Class A, contingent.
		Item 1.—15,000 running feet of round poles 6 to 10 inches in diameter.
		Pr. r. ft.
1	J. E. & D. E. Baily, and Patrick Smith, Cleveland, Ohio; S. S. Stone and W. H. Trescott, Cleveland, Ohio, bondsmen.	$0 05
2	Wm. E. Standart, Elias Sims, and E. M. Peck, Cleveland, Ohio; Jas. M. Coffinburg and J. F. Card, Cleveland, Ohio, bondsmen.	13
3	Henry Fox and W. B. Howard, Chicago, Illinois; J. E. Miller and W. G. Lewis, Chicago, Illinois, bondsmen.	05
4	Hosea Thomas Stock, Toledo, Ohio; Harvey P. Platt and E. S. Platt, Toledo, Ohio, bondsmen.	10
5	John Brown, Thorold, Canada; E. Trowbridge and Geo. Hendric, Detroit, Michigan, bondsmen.	06
6	Hasbrouck & Conro; Stephen C. Walker and Albert E. Goodrich, Chicago, Illinois, bondsmen.	06
7	D. E. Rice, Detroit, Michigan; W. Buchanan and J. Carroll, Detroit, Michigan, bondsmen...	....
8	Brooks & Adams, Detroit, Michigan; E. B. Ward and Christian Buhl, Detroit, Michigan, bondsmen.	....
9	J. S. Miner, Detroit, Michigan; L. M. Mason, and Moore, Foot & Co., Detroit, Michigan, bondsmen.	....
10	Moses Hill, Cleveland, Ohio; Jacob Lawman and Albert T. Slade, Cleveland, Ohio, bondsmen.	....
11	Charles F. Dunbar, Erie, Pennsylvania; Franklin Lee, Buffalo, New York, and S. Dunbar, Toledo, Ohio, bondsmen.	....
12	Buhl, Ducharme & Co., Detroit, Michigan	....
13	Jos. T. Walton; H. P. Baldwin, Detroit, Michigan, and H. A. Fuller, Springfield, Massachusetts, bondsmen.	10
14	Stephen C. Walker, Chicago, Illinois; Andrew J. Wright and Charles G. Wicker, Chicago, Illinois, bondsmen.	08

doing work on St. Clair flats, Michigan.

cation of and prices bid for furnishing materials.					Cost of classes of material.				Total cost of all classes of materials, A, B, C, and D.
Class B.	Class C.	Class D. Manufactured iron.							
Item 1.—5,180 round piles.	Items 1 to 13, inclusive.—All sawed or hewed timber and lumber, 3,684,272 ft., b. m.	Item 1.—5,180 nut and screw 2-in. washer bolts; 1-inch round iron, 37,555 lbs.	Item 2.—7,124 1-inch square bars, 12, 14, and 16 ft. long; drift bolt iron, 364,637 lbs.	Item 3.—Wrought spikes, 5 and 10 inches long, ½ and ⅝ inch in diameter, 18,668 lbs.	A.	B.	C.	D.	
Pr. pile. $4 00	*Pr. M.* $20 00	*Pr. lb.* $0 08	*Pr. lb.* $0 04½	*Pr. lb.* $0 06¾	$750 00	$20,720 00	$73,685 44	$20,673 15	$115,828 59
4 50	21 00	07½	04¾	06¾	1,950 00	23,310 00	77,369 71	21,396 96	124,026 67
3 00	20 00	12½	08	09	750 00	15,540 00	73,685 44	35,545 45	125,520 89
4 75	25 00	09	04½	09	1,500 00	24,605 00	92,106 80	21,468 73	139,680 53
2 80	17 70	07	04¾	07	900 00	14,504 00	65,211 61	23 775 56	104,391 17
3 75	23 00	12	07	08	900 00	19,425 00	84,738 25	31,524 63	136,587 88
....	....	08	05	06¾	....	....	....	22,496 34	....
....	18 00	....	....	....	....	....	66,316 89	....	....
....	15 75	....	....	....	....	....	58,027 28	....	....
....	....	06½	04.6	06.9	....	....	....	20,502 46	....
....	....	....	....	....	....	....	....	....	....
....	....	08¾	04¾	06½	....	....	....	21,819 73	....
5 00	23 00	09	07	08	1,500 00	25,900 00	84,738 25	30,397 98	142,536 23
5 00	22 60	15	09	12½	1,200 00	25,900 00	81,053 98	40,784 08	148,938 06

Abstract of bids for furnishing materials and doing

Number of bid.	Name of bidder.	Classification				
		Class E.				
		Item 1, contingent. — Dredging 3,500 c. y. to ease the driving of piles.		Item 2.—Preparing and driving round piles—5,180.	Item 3.—Preparing, driving, and fastening sheet piles—16,400.	Item 4.—Framing, fitting, placing, and fas'ning all sawed timb'r and lumb'r, besides sheet piles, 341,354 r. feet.
		Measured in banks, not in scows.	Measured in natural b d, not in scows.			
		Pr. c. y.	*Pr. c. y.*	*Pr. pile.*	*Pr. pile.*	*Pr. r. ft.*
1	*a* J. E. & D. E. Bailey, and Patrick Smith, Cleveland, Ohio; S. S. Stone and W. Trescott, Cleveland, Ohio, bondsmen.	$0 33	$0 30	$3 00	$1 00	$0 12
2	*b* Wm. E. Standart, Elias Sims, and E. M. Peck, Cleveland, Ohio; Jas. M. Coffinburg and J. F. Card, Cleveland, Ohio bondsmen.	44	42	3 50	1 00	08
3	*c* Henry Fox and W. B. Howard, Chicago, Illinois; J. E. Miller and W. G. Lewis, Chicago, Illinois, bondsmen.	35	25	2 25	70	08
4	*d* Hosea Thomas Stock, Toledo, Ohio; Harvey P. Platt and E. S. Platt, Toledo, Ohio, bondsmen.	39	34	5 00	1 25	12
5	*e* John Brown, Thorold, Canada; E. Trowbridge and Geo. Hendric, Detroit, Michigan, bondsmen	33	33	2 50	1 30	06½
6	*f* Hasbrouck & Conro; Stephen C. Walker and Albert E. Goodrich, Chicago, Illinois, bondsmen.	40	30	2 25	69	08
	g D. E. Rice, Detroit, Michigan; W. Buchanan and J. Carroll, Detroit, Michigan, bondsmen.	....	....	....	....	....
8	Brooks & Adams, Detroit, Michigan; E. B. Ward and Christian Buhl, Detroit, Michigan, bondsmen.	....	....	....	....	....
9	J. S. Miner, Detroit, Michigan; L. M. Mason, and Moore, Foot & Co., Detroit, Michigan, bondsmen.	....	....	....	....	....
10	Moses Hill, Cleveland, Ohio; Jacob Lawman and Albert T. Slade, Cleveland, Ohio, bondsmen.	....	....	....	....	....
11	Charles F. Dunbar, Erie, Pennsylvania; Franklin Lee, Buffalo, New York, and S. Dunbar, Toledo, Ohio, bondsmen.	....	....	....	....	....
12	Buhl, Ducharme & Co., Detroit, Michigan........	....	....	....	....	....
13	*h* Jos. T. Walton; H. P. Baldwin, Detroit, Michigan, and H. A. Fuller, Springfield, Massachusetts, bondsmen.	50	42	3 50	75	06
14	*i* Stephen C. Walker, Chicago, Illinois; Andrew J. Wright and Charles G. Wicker, Chicago, Illinois, bondsmen.	34	24	3 50	1 20	09

a We wish the award of the whole, or of classes C, D, E, or F, either or all.
b Desire the award of all in classes A, B, C, D, and E, or none, and whole in class F or none.
c Will take whole work or a part.
d The whole or none.
e Bid for the whole, but will accept classes E and F, if awarded, or any class upon which he may be lowest.
f Will take any portion or the whole.
g Will take any of the items at the price named.
h I bid for the whole or any class that may be assigned me.
i The bidder does not conform to the advertisement in an essential point.

I certify that the above bids, Nos. 1 to 13, inclusive, have been truly entered, and that this is a true abstract

I certify that No. 14 is a true abstract of a bid which was put in, but which did not conform to the adver
ayed three days longer than necessary for him to reply and make his bid to conform to the advertisement.

work on St.' Clair flats, Michigan.—Continued.

of and prices bid for labor.					Total approximate cost of classes A, B, C, D, E, and F, suppo-ing half of the dredging measured in natural bed and half measured in canal dikes and banks, including, by the same rule, contingent dredging in class E.	Total approximate cost of the work, classes A, B, C, D, E, and F.	
		Class F. Filling by dredging between dikes to make the canal water-way and dumping into dikes and beyond them so as to form the canal banks perfect in shape, 618,280 cubic yards, (approximate estimate.)					
Item 5, contingent.—Framing, fitting, putting in, and fast'ning round piles, 15,000 running feet.	Total cost of class E, supposing the contingent dredging measured half in natural bed and half in dikes and banks.	Measured in the canal banks as completed, not in scows.	Measured in the natural bed before dredging, not in scows.	Cost of class F; half dredging measured in dikes or banks and half measured in natural bed or cut.		If all dredging measured in dikes or banks, including contingent dredging in class E.	If all dredging measured in natural bed, including contingent dredging in class E.
Pr. r. ft. $0 05	$84,677 48	*Pr. cubic yd.* $0 38	*Pr. cubic yd.* $0 35	$225,672 20	$426,178 27	$435,977 47	$406,379 07
04	80,488 32	44	42	265,860 40	470,375 39	477,908 19	463,842 59
03	64,393 32	45	35	247,312 00	437,226 21	469,890 21	404,562 21
06	101,037 48	39	34	225,672 20	466,390 21	491,722 21	450,058 21
04	68,608 01	39	33½	224,126 50	397,125 68	414,128 38	380,122 98
05	66,279 32	42	32	228,763 60	431,630 80	464,294 80	398,966 80
....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....
....	....	45	37½	255,040 50	....	....	....
....	....	....	....	....	....	....	....
04	67,611 24	50	42	284,408 80	494,556 27	520,687 47	468,425 07
08	79,881 86	36	42	200,941 00	429,760 92	453,150 72	406,371 12

of all bids received and which conform to the requisitions set forth in the advertisement hereto attached.

T. J. CRAM, *Col. of Eng'rs, Brevet Major General.*

tisement, and that the bidder, after being apprised of the defect, has not complied, although this has been de-

T. J. CRAM, *Col. of Eng'rs, Brevet Major General.*

B 17.

ENGINEER DEPARTMENT,
Washington, August 17, 1867.

GENERAL: Your letter, enclosing an abstract of bids for the St. Clair flats improvement, made in conformity with engineer department letter of July 6, and the terms of your advertisement of July 23, was received at this office on the 16th instant.

You will make the awards of the contracts by classes to the lowest responsible bidders for each class, and if any should fail to comply with the terms of their bids, you will award to the next highest responsible bidders, with the understanding that the delinquents will be held accountable to the United States to the extent of the guarantee accompanying the bids.

Your attention is also called to the concluding paragraph of department letter to you of the 21st May last, viz: "You will enter into contracts only for so much of the material as may be advantageously used in executing the plan of improvement to the extent practicable with the appropriations made for it, namely, $230,000, leaving sufficient of that sum for the contract for work to be done, including dredging.

"Any other course would result in procuring a large amount of material without the means of putting it in place until Congress should make further appropriations."

Very respectfully, your obedient servant,

I. C. WOODRUFF,
Lieut. Col. of Engineers, Brevet Brig. Gen. U. S. Army,
Assistant in charge.

Brevet Major General T. J. CRAM, U. S. A.,
Colonel of Engineers, Detroit, Michigan.

B 18.

ENGINEER DEPARTMENT,
Washington, August 28, 1867.

GENERAL: Your letter of the 23d instant, enclosing contract in duplicate entered into with John Brown, of Thorold, Canada West, with bond for the faithful performance of the same, for material for the St. Clair flats improvement, and contracts in duplicate with the same, with bond, for labor for the same improvement, has been received.

The contracts are approved, and you will notify the contractor accordingly.

Very respectfully, your obedient servant,

I. C. WOODRUFF,
Lieut. Col. of Engineers, Brevet Brig. Gen. U. S. Army,
Assistant in charge.

Brevet Major General T. J. CRAM, U. S. A.,
Colonel of Engineers, Detroit, Michigan.

B 19.

UNITED STATES ENGINEER OFFICE,
Detroit, June 12, 1867.

SIR: Herewith I forward abstract of bids received on my invitation for dredging Sandusky river, Ohio, below the town of Frémont. See printed notice hereto attached. Thomas Dunbar & Co. being the lowest responsible bidder, I have to request authority to make the necessary contract with him, having already notified him that he is the lowest bidder.

I have the honor to be, very respectfully, your obedient servant,

T. J. CRAM,
Colonel of Engineers, Brevet Major General.

Major General A. A. HUMPHREYS,
Chief of Engineers United States Army.

To contractors.

OFFICE OF LAKE HARBOR AND RIVER IMPROVEMENTS,
No. 111 *Griswold street, Detroit.*

Written and sealed proposals will be received at this office, addressed to the undersigned, until the 31st day of May, 1867, for dredging in the Sandusky river, below Frémont, Ohio, to obtain twelve feet water.

Places to be dredged.	Cubic yards at each place.	Width of channel to be obtained.
		Feet.
1. At Whitacre bar	43,610	160
2. At bar below Nigger Point	13,176	200
3. At South Creek bend	22,916	200
4. At point two and a half miles below Frémont	15,503	200
5. At point three-fourths mile below Whitacre bar	10,333	200
6. At point one-third mile lower down	111	200
7. At outer bar, mouth of the river	79,426	160

The earth dredged to be dumped at such places that it will not wash in so as to form another shoal.

The government reserves the right to diminish the amounts of dredging above specified, so as to keep the work within the appropriation. The work to be commenced by the middle of June, and continued during the season with dredges of power at least sufficient to raise five hundred yards per twelve hours each. State the price per cubic yard for dredging, towing, and dumping at each place specified; also, the names and residence of bidder and the two bondsmen. The material is soft for dreding, and all the places to be dredged only some few miles below the town of Frémont. For further particulars apply in person, at this office, where the map of the survey can be seen.

T. J. CRAM,
Colonel Corps of Engineers, Brevet Major General.

Abstract of bids for dredging Sandusky river, Ohio.

No. of bids.	Names of bidders and residence.	Names of bondsmen and residence.	Price bid for dredging per cubic yard.	Total cost, 185,075 cubic yards.
1	John F. Hosch, Mohawk, Herkimer county, N. Y.	Elliot Harnun and Willard Johnson, Fulton, Oswego county, N. Y.	38 cents; all places measured in dump scows.	$70,328 50
2	Harvey P. Platt and H. S. Stock, Toledo, Ohio.	A. C. McNair and Henry M. Clafton, Cleveland, Ohio.	For all except outer bar, 33⅔ cents; outer bar, 39 cents, measured in dump scows.	105,649 cu. yds, $35,568 50; 79,426 cu. yds, $30,976 14.
3	Thomas Dunbar & Co., Toledo, Ohio.	L. Q Ramson and Chas. Fillmore, Frémont, Ohio.	27 cents; all places measured in dump scows.	$49,970 25

I certify this to be a true abstract of the original bids.

F. J. CRAM,
Colonel Engineers, Brevet Major General.

B 20.

UNITED STATES ENGINEER OFFICE,
Detroit, August 17, 1867.

SIR: The following special report upon Vermillion harbor, Ohio, I think it my duty to make, and which will explain itself.

In my estimate for repairs and preservation of this work I made it amount to only $15,315 94 in the (my) report of 20th February, 1865. Congress made this appropriation in 1866, and I thought in my annual report of that year this sum would be all that would be required to complete the repairs and preservation of the works. I have or shall soon have expended all the appropriation, and find that I have done considerable more work than I estimated for. During the present summer more critical examinations have been made than it was possible to make in the winter of 1865, and we have found serious damages to the under-water work, deep down, which may have been produced since that winter examination.

The old under work of west pier, much of it, was made with miserable round timber, no better than poles, and put together in the roughest manner—no better than a boy's "cob house." Wooden pins were used, which have been cut off by the sharp sand moved by the current, and the logs been washed out, and stones too. Several of these large holes have been repaired, at much expense, by means of bundles of brush and sheet piles, in a way that could not be done by contract, and thus far, I hope, we have been successful in preserving several hundreds of feet of that old pier not foreseen to be in danger.

But another danger now threatens. Having stopped a 400 feet breach in old west pier, (estimated for in said report,) and rebuilt that, a current now sets in-shore along the west side of that pier, cutting away the bank and threatening several hundred feet of the low part of that old pier, away in-shore, and which I am fearful, unless repaired this season and preserved, will be found gone next spring.

I have gone through with a careful estimate of what it will cost to save the whole of the existing old west pier, and prevent the in-shore breach, and build the low part up to the proper height above water, and ballast it with stone, putting in all new timber that will be required—in short, doing justice to the work, and which would make it last many years to come—and find it will cost only about $8.000 more than I shall have left of the appropriation specific. There are two reasons why I wish to do this complete repairing the present season.

1. The contractor is there ready with his force and willing to do it, straight on, and the timber contractor will, if soon notified, deliver all timber at one cargo. The bills are all made out, and detail plans.

2. It will in all probability cost less by one hundred per cent. if preserved now than it will next year, if we wait for another specific appropriation, because the damage is going on in an increased proportion with the time of postponement.

Now I have to request authority to draw upon the appropriation of 1864 for "repairs and preservation of lake harbor works" (not requiring advertising for proposals) to the amount of $8,000—say $9,000 for the purpose stated in this special report—and which had better be now applied to this harbor than to any other in my district.

I have the honor to be, very respectfully, your obedient servant,

T. J. CRAM,
Colonel Corps Engineers, Brevet Major General.

Major General A. A. HUMPHREYS,
Chief of Engineers United States Army.

P. S.—I have now on hand $9,062 88, left of the said appropriation for 1864. Some of it will be wanted, say about half, possibly, at Erie—old interior part of north pier.

B 21.

Report of the survey of Grand river harbor, made in accordance with instructions from the engineer department, of date September 19, 1866. Survey made in the month of January, 1867, by T. J. Cram, colonel engineers, brevet brigadier general.

1. The suggestion made in the instructions to make this survey "soon after the abatement of the autumnal gales, or about the last of October," was attempted to be carried out in good faith. My then assistant, Brevet Major Farquhar, captain of engineers, was sent to the harbor with instructions to make the survey, but soon returned, reporting his failure in consequence of stormy weather. The absence (on leave) of the major and the continued stormy weather prevented the survey from being made until the present month, when, the ice having formed sufficiently strong to bear a working party, I took the survey into my own hands, and completed the field-work on the 19th instant, in snow up to the waist.

The soundings were taken with the utmost accuracy, the holes having been cut through the ice and the depths of water measured exactly as represented on the accompanying map, A. The whole network was laid out on the ice in rectangles, and the holes cut accordingly. The soundings have been taken from deep water of the interior of the harbor and carried out over the bar in the flaring mouth to 15 feet water in the lake, in exact accordance with the instructions. The level of the surface of the water, when the survey was made in August, 1865, was referred to a bench-mark. On the 18th instant, (January, 1867,) by my levelling, the surface of the water was referred to the same bench-mark, and found exactly 0.314 foot lower than it was in the former survey.

Map B, accompanying this report, is a representation of the survey of August, 1865, and by comparing it with A, will enable the department to judge of the effect of the outflow in sweeping out the sand since I put this work in order by stopping the breaches in both piers, for it was just about the time of the closing of the breaches that the survey of the summer of 1865 was made.

In making the comparison of the soundings care should be taken to apply the number 0.314 foot properly.

2. Comparisons showing the fruits resulting from the complete repair of the old piers.

The portion of the area of the plotted soundings limited between the lines *c d* and *a b* on map A, and C D and A B on map B, may be regarded as the horizontal projection of the bar obstructing navigation at the mouth of this harbor. The mean of all the soundings between the said limits in A is (January, 1867) 9.508 feet.

The mean of all in B was (August, 1865) 8.683 feet. From the latter subtract 0.314 foot, and we shall have 8.369 feet, as the mean depth for survey B, referred to the same stage, with the survey A of the present winter.

Hence, since August, 1865, we perceive that the mean top surface of the obstruction between the said limits has been lowered by 1.139 foot, or about 13½ inches, which may be regarded as the measure of the good effect in moving away the general obstruction resulting from the repairs.

But the mean depth of water over an obstruction gives no just idea of the capabilities of the channel for navigation. The least depth, direction, and width of channel way are required to be known, before the navigator will attempt the passage.

It will be seen that at the stage of water and least depth for A, no vessel drawing over 7½ feet can pass the obstruction, supposing no ice at the present time.

On examination of the map B, of the survey of August, 1865, we find that then the least depth in the channel over the bar was just at the neck of the flare, where, in fact, the water was only 4½ feet deep—the outflow of the river then being principally through the old east pier into the basin, thence through the loose sand into the lake.

The difference (3 feet) of the least depths, augmented by 0.314 foot, gives us 3 314 feet as the measure of the good effect in deepening the channel, caused by the repairs of the piers, and compelling the outflow to act more directly upon the obstruction.

These results have been realized, under the force of the outflow of the river, animated by one vernal and two autumnal freshets, since the piers were repaired.

The dotted lines show the present direction of the channels over the obstruction, the most westerly one being rather the best, and more strongly characterized in depth. Between them there are indications of a middle ground forming. These indications teach us that to contract the mouth, by an extension of the east pier around parallel to the west pier, is the best way to remedy the evil of the flare, which was unfortunately given to its outer part.

The width of the entrance would be ample after making the contraction, and access easy.

In regard to the outflow of the river, referred to in the instructions: This is the greatest, and of much strength, when the winds blow from a southeasterly around by south, and from a southeasterly direction. Then the lake water is driven away from the harbor, and the current of the river has its greatest velocity. In such a blow for twelve hours, last autumn, the waters in the harbors on our shore of this lake fell from three to five feet. After the succeeding lull, the inflow is proportionally great.

When the wind blows from the west around by north, and from east, the velocity of outflow is least, and the effect of the current upon the bar is less and less in proportion to the absolute strength and duration of the gale. After the lull, the river again resumes its effect upon the bar.

3. In conclusion, the "oldest and best-informed inhabitants" of the place

informed me that before and up to the time of commencing the flare of the west pier there was ample water for the purposes of this harbor, whether viewed in regard to the commerce then existing at the place or in the aspect of a harbor of refuge, and that immediately after the flaring position was constructed the water began to diminish in depth at the mouth, and the harbor rapidly deteriorated from having a twelve-feet entrance to the condition in which I found it in September of 1864, and as explained in my report of the 26th of that month. From that report I quote the following, which is just as applicable now as it was then:

"Were we to act merely to subserve a supposed existing commerce at Fairport, inasmuch as there is no commerce there demanding a harbor, we should let the whole harbor go by the board and leave it to its fate. But if it be deemed of sufficient importance, as a harbor of refuge, to justify its restoration, then it would be best to repair it to the full extent required, but not to repair in part unless we have means enough to restore the whole [meaning to include the channel] to a full degree of usefulness for this (refuge) purpose Any other course of repairs or plan of restoration coming short of this end would be tantamount to throwing money away upon it."

I was directed to go on by the engineer department and to repair all the old piers, though I gave reasons in the same report why it would be better and cost less to abandon the old flare of the west pier and extend a work for "preservation" out parallel to the east pier. The sum of $24,453 24 has been expended under the order. My original estimate for the thorough repairs of all the old piers ordered by the department was $30,726. I am happy to find that all has been accomplished for less, by $6,272 76, than the estimate, and the piers are now stronger than ever before, and the work better done by thirty-three per cent. than was the original work.

The above expenditure has been made under the act of 1864 making appropriation for "repairs and preservation" of works. Under this wording I held that we were authorized to construct a work from an angle of the west pier straight out, parallel with the east pier, as a means of "repairing" the damage done by the sand having accumulated to block the channel entrance. No one will deny that the channel, whether natural or artificial, is the main vital part of the harbor. For "repairing and preserving" the vital part all the other parts of a harbor work are but means to an end; and upon such means as I suggested as adapted to the end of "repairing and preserving" the channel, I still think the money under that act could have been legally applied, instead of following the old good-for-nothing, nay, worse than nothing, flaring part around to its extremity. But I was overruled.

Foreseeing that such an expenditure would not accomplish the object with which we started, viz., the restoration to a harbor of refuge, I submitted a plan and estimate, in my annual report of 1864, for extending the east pier around parallel, as a last resort, to the flaring part of the west pier, giving reasons in full in that report and in a subsequent one, dated August 31, 1866, for assigning such a direction for the extension in preference to constructing it on the prolongation of the straight line of the east pier. It is unnecessary here to repeat those reasons. The recent survey confirms me in the belief that the direction I suggested for the extension will best contribute to the end of restoring the harbor to its original capacity for refuge and for remedying the evil produced by the flare.

Congress made an appropriation for the exact amount I estimated. The estimate was for a work denominated a close "pile pier," and not for a crib work, as the latter would cost twenty-five to thirty per cent. more. The engineer department letter of August 23 last, however, seems to favor a crib work.

The proposals I received were predicated upon the plan of the pile pier, which

I hope the department will sanction for whatever direction the extension may be made to follow.

I take it the object still is to restore the harbors to a condition for refuge. The sooner this is done the better, and the successful bidder should be contracted with immediately to proceed to furnish the piles and timber. If it be put off until the opening of spring we cannot possibly get the materials in time to make but very little of the extension next summer.

I believe I have now complied with all the requirements of the order of 19th September, 1866.

I have the honor to be, very respectfully, your obedient servant,

T. J. CRAM,
Colonel of Engineers, Brevet Brigadier General.

Brig. and Bvt. Maj. Gen. A. A. HUMPHREYS,
Chief of Engineers.

DETROIT, *January* 24, 1867.

SIR: I herewith transmit my report of the survey of the harbor of Grand river, Ohio, made in virtue of engineer department instructions of September 19, 1866.

Observe: The successful bidder for furnishing the piles, stone, and for doing the work, was the firm J. E. & D. E. Baily; for furnishing the square timber and lumber, N. W. Brooks & Co.; and for furnishing the iron, Cleveland Union Iron Works. Better contractors could not be desired.

The Bailys put in, supposing the extension to be a pile pier work, but will hold to their bid, even though a crib work be made. The notice for proposals was duly published when we advertised for other works, and this formality and delay have been complied with. Any direction the department may feel authorized to give, I submit had best be done soon, or we may forfeit the advantage of the bids of the above named contractors.

This is the season for cutting and gathering the piles, and for cutting the logs for the square timber and lumber.

Very respectfully, your obedient servant,

T. J. CRAM,
Col. Corps of Engineers, and Bvt. Brig. Gen'l.

Brig. and Bvt. Maj. Gen. A. A. HUMPHREYS,
Chief of Engineers.

B 22.

ENGINEER DEPARTMENT,
Washington, February 8, 1867.

GENERAL: Your report of the 24th ultimo, upon the proposed improvement at the harbor of Grand River, Ohio, accompanied by a map of your survey, made in the month of January, has been carefully considered, but the department does not concur in the proposed bend in the extension of the east pier, for the reason, mainly, that the flow outward would have a tendency to scour the bottom close along that pier only, which vessels entering in stress of weather would, of course, by the narrowing of the channel-way, be compelled to hug, and thus be forced against it, to the injury both of the vessel and the structure.

The comparison of your recent survey with that of August, 1865, leads to the conclusion that the extension of the east pier on the present line of direction, would produce a favorable result; the latter channel at the present time being nearly on the prolongation of the east pier, resulting evidently from the repairs of the breaches in the two channel piers, which now restrict the flow of water in a straight course into the lake. (See comparative sketch herewith.)

You are authorized to contract for the materials for the east pier extension, with the distinct understanding that if for pile pier, the fact of a clay bottom be established before commencing the structure; but if the bottom be of drifting sands, then the structure shall consist of cribs with stone ballast.

Very respectfully, your obedient servant,

A. A. HUMPHREYS,
Chief of Engineers.

Brevet Brig. General T. J. CRAM, U. S. A.,
Colonel of Engineers, Detroit, Michigan.

B 23.

UNITED STATES ENGINEER OFFICE,
Detroit, June 18, 1867.

SIR: I herewith transmit my report upon Dunkirk harbor, New York, the result of my examination of that harbor, and a study of the question. As soon as I receive the approval of the proper authority I will advertise for proposals, with a view of getting the work under contract as soon as possible.

I have the honor to be, very respectfully, your obedient servant,

T. J. CRAM,
Colonel Corps of Engineers, Brevet Major General.

Major General A. A. HUMPHREYS,
Chief of Engineers United States Army.

Report upon the harbor of Dunkirk, New York, by T. J. Cram, Brevet Major General, Colonel Corps of Engineers, June 20, 1867.

The order from the engineer department of 28th of March, assigning this work to my charge, under the appropriation by act of 2d of March, 1867, directs me to follow the plan presented by Major Tardy, late of the corps of engineers, unless I dissent, in which event, by the same order, I am directed to report my views.

Having recently made a thorough inspection of the harbor, and having had certain data which I directed to be obtained by my assistant, Brevet Lieutenant Colonel F. Harwood, captain corps of engineers, returned to me in actual measurements by that officer, I am enabled now to report my views as follows:

1. I cheerfully agree with the plan proposed by the late Major Tardy in so far as the extent of the west pier, P, and the breakwater, B, and their locations and heights above water, are concerned, and seen on the accompanying tracing from the map of the survey of 1866, and in reference to which he made the estimate upon which Congress appropriated $100,000. I also concur with him in dissenting from the further attempt to carry out the plan of three detached outer breakwater constructions to be placed in eighteen feet water, and recommended by the "board of engineers lake harbors and western rivers, July 12, 1854." What was executed, about 250 feet, at great cost, has never been of any advantage to this harbor, but of positive disadvantage to vessels in a storm seeking the entrance, nor would it be of half the advantage, if completed in toto, as would be the pier P and breakwater B.

I must, however, express my dissent from the plan proposed by Major Tardy in regard to the thickness to be given to P and B, also in respect to building of the superstructure above water, of B, in masonry. Instead of twenty-five feet in thickness for P and B, I would make P sixteen feet and B eighteen feet, and have the superstructure of both of timber and rubble stones, and well planked over. On the lakes we have the experience of two very expensive piers in what is called stone masonry superstructure upon crib foundation. They have not lasted as well as properly constructed timber and rubble-stone work without very expensive repairs, and the interest at six per cent. per annum on the excess of first cost of the masonry over the timber and rubble-stone superstructure is much more than would be sufficient to keep the latter in perfect repair for all time. I shall go more into this comparison in my report upon Buffalo harbor constructions.

I think the true policy is to construct P first and completely, and afterwards, when we get an appropriation sufficient in advance for the whole of B, to construct it, but not to begin on B until enough has been appropriated to complete it.

These two works, P and B, completed, Dunkirk will have as good a harbor as the case admits; and with only P completed the harbor will be greatly improved, certainly enough to justify the cost. The supposing that P and B will obviate the necessity of dredging occasionally from the railroad piers out to the beacon-light passage into the outer water must not be encouraged. Artificial dredging will have to be resorted to for preserving a twelve-feet channel at low stage.

2. I have all the plans in detail and bills of materials made out for P, and shall be ready, on receiving from the engineer department an approval of my views, to put the work in advertisement for construction.

I have the honor to be, very respectfully, your obedient servant,

T. J. CRAM,
Colonel of Engineers and Brevet Major General.

Brigadier General A. A. HUMPHREYS,
Chief of Engineers and Major General of Volunteers.

B 24.

UNITED STATES ENGINEER OFFICE,
Detroit, July 25, 1867.

SIR: I send herewith an abstract of bids for Dunkirk harbor, New York, from which it will be seen that for the material and labor the lowest responsible bidders are:

For classes A, B and D, Alexander McDonell, amounting to	$32, 835 69
For class C, R. Nelson Gere	2, 099 71
Total	34, 935 40

Both, with the bondsmen named, are responsible. As soon as the proper authority may give me instructions I will draw up the requisite articles of agreement and bonds of indemnity, and have them duly executed.

Respectfully, your obedient servant,

T. J. CRAM,
Colonel of Engineers and Brevet Major General.

Major General A. A. HUMPHREYS,
Chief of Engineers United States Army.

Abstract of bids received for Dunkirk harbor, New York.

Number of bid.	Names and residences of bidders and of bondsmen.	Prices bid for furnishing classes of material.						Cost of class C—iron materials.	Cost of classes A, B, and C—all materials.	Prices bid for classes of labor.				Cost of class D—labor.	Entire cost of materials and labor, or of classes A, B, C, D.
		Class A.	Class B.	Class C.						Class D.					
		Item 1.—116 piles.	Item 1 to 29.—699,428 ft. b. m. sawed stuff.	Item 1.—42,666 lbs. iron.	Item 2.—203 lbs. 6d. spikes.	Item 3.—24,994 lbs. 5d. spikes.	Item 4.—72 lbs. nails.			Item 1.—33,704 r. feet.	Item 2.—20,399 r. feet.	Item 3.—1,183 cords.	Item 4.—63,403 feet, b. m.		
		Per pile.	*Per M.*	*Per lb.*	*Per lb.*	*Per lb.*	*Per lb.*			*Per r. foot.*	*Per r. foot.*	*Per cord.*	*Per M.*		
1	*W. H. Mott, Detroit, Mich.; M. E. Standart, Z. T. W. Richardson, Cleveland, Ohio, bondsmen.	$6 50 754 00	$29 00 19,703 41	$0 05½ 2,186 63	$0 07 14 21	$0 07 174 58	$0 08 5 76	$2,381 88	$22,838 59	$0 14 4,718 56	$0 12 2,447 88	$15 00 17,745 00	$7 00 443 85	$25,355 29	$48,193 88
2	A. F. Gay, Detroit, Mich.; H. M. Loud. A. B. Loud, Ausable, Mich., bondsmen.		$23 90 16,238 32												
3	Brooks & Adams, Detroit, Mich.; E. B. Ward, C. H. Buhl, Detroit, bondsmen.		23 00 15,626 84												
4	†Thos. J. Skidmore, Fredonia, N. Y.; O. W. Johnson, Fredonia, W. H. Briscoe, Oswego, N. Y., bondsmen.	16 00 1,856 00	24 50 16,645 98	7 2,986 62	10 20 30	10 249 40	6 4 32	3,260 64	21,762 62	20 6,740 80	15 3,059 85	12 00 4,196 00	15 00 951 12	24,947 77	46,710 39
5	‡Andrew Spaulding, Buffalo, N. Y.; O. Frederick Balm, Lewis J. Bennett, Buffalo, bondsmen.	6 00 696 00	24 00 16,306 27	6 2,559 96	8 16 24	8 199 52	7 5 04	2,780 76	19,783 03	12 4,044 48	9 1,835 91	10 00 11,830 00	9 00 570 67	18,281 06	38,064 09
6	§ Alex. McDonell, Hamilton, C. W.; W. H. Douglas, Ambrose Clark, Buffalo, N. Y., bondsmen.	4 00 464 00	22 00 14,947 41	6½ 2,773 29	8 18 57	9 224 46	10 7 20	3,023 22	18,434 63	10 3,370 40	8 1,631 92	9 75 11,534 25	14 887 71	17,424 28	35,858 91
7	‖ King & Vincent, Erie, Pa.; James Hoskinson, Elijah Babbitt, Erie, bondsmen.	10 00 1,160 00	24 00 16,306 27	5 2,133 30	10 20 30	10 249 40	10 7 20	2,410 20	19,876 47	15 5,055 60	15 3,059 85	12 00 14,176 00	12 00 760 96	23,072 41	42,948 88
	R. Nelson Gere, Syracuse, N. Y.; N. Stanton Gere, Charles E. Hubbell, Geddes, N. Y., bondsmen.			4.4 1,911 43	6.8 13 80	6.8 169 59	6.8 4 89	2,099 71							

* Will accept the award of the whole or none bid for.
† Bid for whole or none to be awarded.
‡ Will accept the award for all classes, or any class proposed for.
§ Will accept the award of the whole, or classes A, B, D.
‖ Desires the whole, but would take the contract without item 1, class C. In letter of 13th, says whole or none.

I certify the above to be a true copy of the abstract of the original bids.

T. J. CRAM, *Colonel of Engineers, Brevet Major General.*

B 25.

UNITED STATES ENGINEER OFFICE,
Detroit, June 27, 1867.

SIR: I herewith forward my report (commenced 20th June, and closed this morning) upon Buffalo harbor, in response to engineer department's letter to me of March 28, 1867, placing the work under my charge.

It is an important subject, one which has required much physical and mental labor, patience and perseverance, on my part, to comprehend.

I found it necessary to direct borings, soundings, and other measurements to be made, so as to know upon what and in what we have to build. These have not all as yet been returned to me. They are, however, in progress, and as soon as received I shall be able to make out detailed plans of construction and issue proposals. None of these, however, until after the receipt of the approval from proper authority of my views.

I have the honor to be, very respectfully, your obedient servant,

T. J. CRAM,
Colonel Engineers, Brevet Major General.

Major General A. A. HUMPHREYS,
Chief Engineer, United States Army.

Report upon the harbor of Buffalo, New York, by T. J. Cram, brevet major general, colonel corps engineers, June 20, 1867.

In the orders March 20, 1867, from engineer department, assigning this work to my charge, it is said, in case I dissent from the plan of construction proposed by the late Major Tardy, I am requested to submit my views.

I have recently examined this harbor with much care, and in the mean time witnessed the dangers and difficulties of vessels entering it under one of those "three days' storms" which not unfrequently occur there. I have not only witnessed for myself the practical defects and wants of the harbor, but I have consulted with the old and experienced lake navigators who have been familiar with its working since it was first improved, and with all the subsequent changes or modifications in character, kind, and dimensions of lake vessels, sail and steam, and which have been constructed to keep pace with the growth and demands of commerce. My consultations with these men have been of much benefit, begetting a spirit of discussion which has not failed to elicit much practical information that the engineer should by no means neglect, if he wishes to do justice to this highly important harbor in any future work that may be adopted for its improvement and completion.

Never before having had any official connection with the work, I had of course no bias or predilection in favor of any particular plan. Nor did I know what plans had been projected by any officer preceding me. It became my duty, however, on receipt of the order placing it in my charge, to study the question in all its bearings, not only in reference to the immediate wants of the commerce now especially tending to Buffalo, but also in reference to the wants of the future of this commerce in its demands for safety for vessels, whether intending to discharge at Buffalo, or seeking refuge there during heavy blows so prevalent at that end of the lake.

I.—HISTORY OF THE HARBOR WORKS AND THE PLANS FOR ITS IMPROVEMENT PRIOR TO THE PRESENT TIME.

Sketch A shows the first improvement ever made at the mouth of Buffalo creek.

In the summer of 1818, William Peacock made a survey for this harbor.

The State of New York, in 1819, loaned $12,000 for its construction to a committee of citizens on security to execute the work.

Samuel Wilkensen superintended the construction, which was commenced in 1820, and finished in two hundred and twenty-one days, in the year 1821. The south pier consisted of timber cribs, filled with stone and brush, and extended one-fourth of a mile into thirteen feet of water. The north pier consisted of a double row of piles filled with brush and sand. The work cost $14,000, and furnished a good harbor. The first lake steamer, Walk in the Water, was lost, and the second, the Superior, was built in Buffalo in 1822, and ready to enter the lake in the spring of 1823. The completion of the harbor was considered a great success, demonstrating that harbors could be built by piers at the mouths even of the small streams of value to the infant commerce of the lakes. The completion of the harbor, and the success attending it, were the strong inducements the Erie canal commissioners had in deciding them to extend their canal to Buffalo and terminate it there, rather than leave its terminus at Black Rock, whose harbor works (called General Porter's harbor) are also shown on A. In 1826, the Congress of the United States appropriated $15,000 for the improvement of the Buffalo harbor; upon that the United States engineer took possession and made it a government work. He broke up the top part of the pier Mr. Wilkensen had built to build upon the under water part a new superstructure; before this was put on, however, much of the Wilkensen work, left after tearing off the top, was destroyed by the first gale of wind. The government has in all, up to include 1864, appropriated and expended upon the piers at this harbor the aggregate sum of $266,794. For this aggregate, and the sum of $14,000, first cost of the original piers, making $280,794, we have as a result two piers, marked S and N on sketch B; the south fifteen hundred feet in length, and the north six hundred and thirty feet in length, built with cribs of wood, filled with rubble stone under water as a foundation, and of a kind of stone and cement masonry above water. The cross sections of these show they were built with an outside shell filled with a kind of a grouting, not deserving the name of concrete, for the heart. These are now in a damaged state, and their repairs will furnish the subject of chapter IV in this report.

II.—DIFFICULTIES OF THE HARBOR.

The sand moved by the littoral current is carried along parallel with the shore, which is at the southward, forming an accretion back of the pier, and carried after a while around the head of S and deposited in a bar at the very mouth of the harbor; and frequently a current exists drawing the sand further into the harbor, which is the effect of so many draughts upon the lake water to feed the Erie canal, as are seen by the feeders (called slips) 1, 2, 3, map B. The Buffalo creek above the harbor is also drawn very liberally upon through the other slips represented on B for water which likewise goes to feed this canal. The Buffalo level of Erie canal is thus furnished with water; and the several mills some distance down towards Black Rock are also furnished with all their power through these slips, drawing a vast quantity of water during summer and winter from the harbor and creek. The outflow of Buffalo creek under such circumstances is not sufficient to sweep out the lake sand that comes around the head of the pier, and hence the harbor channel is obstructed by this sand deposit, and it always will be, however much we may extend the piering, and there are no means except artificial dredging occasionally, as it may be required, to remedy the evil, unless preventive jetties or piers are thrown out from the shore at a considerable distance south of the harbor to act as sand catchers.

The city of Buffalo is at considerable expense annually for dredging this deposit, and I do not see how this tax upon commerce can be obviated unless by the means suggested; but this dredging is an inconvenience and expense, for so large a commercial place, of *minor* importance compared with other disadvantages now to be explained.

Erie breakwater.—This is seen in location on map B, and was constructed at great expense by the State of New York, to cover a basin in which canal boats and other vessels in connection with the canal business could lie in safety from the great swells produced by the southwest winds, which are the prevailing, and are those under which all the difficulties of entering the harbor of Buffalo are severely felt. Previous to the construction of that breakwater a vessel coming in under these winds, if she could not round up in time to make a lee on the north side of pier S, would ground on the soft bottom near the shore north of pier N, and sustain comparatively little injury. But since that breakwater was constructed, projecting as it does so near to pier S, vessels coming in under stress by these storms are very liable either to strike on the breakwater or on the sand deposit before they can make sufficient lee. No small number of valuable vessels have been forced on the southern part of this breakwater, and destroyed sometimes, both vessel and cargo. The breakwater is stone superstructure, similar to S, resting on a crib under-water foundation. Sometimes the vessel in attempting to escape the breakwater in wearing runs head on against the pier S.

The breakwater, as well as S, are both in a much injured condition, in consequence of these collisions. Such masonry work as the pier and breakwater are constructed of have no more, if as much, capacity to resist the shocks than a *well-constructed* timber and rubble-stone superstructure, as is already evidenced by this stone pier, and the stone pier at Cleveland, neither of which has resisted the shocks and washing of the waves, and action of the frost, as well as a wood and rubble-stone superstructure.

Every vessel-owner and shipmaster in Buffalo, of any experience, condemns, in bitter terms, the Erie breakwater. All say that one of the improvements needed for the harbor is to remove about 400 feet of the south end of that breakwater. This would give a chance for the vessels under those southwestern gales to enter without striking. They also say, that in any well-devised plan for the improvement by enlarging the harbor, there will be no difficulty in obtaining the consent of the New York legislature authorizing the United States engineer to remove a portion of the south end of that obstruction, and use the materials, free of charge, in any work of improvement of the harbor. I agree fully with their condemnation of the south part of that structure, and I think that one has only to draw a line from the southwest into the mouth of the harbor, and he will see how difficult it would be, under a violent wind from that direction, for a vessel to obtain sufficient lee, under S, before striking the breakwater, especially as vessels have been so greatly increased in length since that work was completed.

III.—PLANS FOR IMPROVING THE HARBOR.

What I shall propose will compensate, in measure, in covering the basin from the effects of the prevailing wind just in proportion as we may take away from the breakwater, simply by an increase of the pier S, so as to leave the same security to vessels in the basin as there now is, and at the same time give us more extent of lee for vessels on north side of S, and also, at the same time, more space between the breakwater and the pier, and insure a third advantage besides, which will consist in affording more section of channel for drawing the water through to feed the canal, and, consequently, less velocity of currents to move the sand into the mouth of the harbor; or it will insure an equivalent by an increased effect of the outflow of the creek in its efforts to force back that sand. These ideas are illustrated on sketch C. Draw through any point *p*, on the prolongation of S, a line from the southwest, the direction of the prevailing winds. It is seen this line cuts off a portion x from the breakwater, which will be found from the general equation—

$$x=\frac{2}{3}d,$$

from which, by assigning a given number of feet to d, we shall find the corresponding values in feet for x.

Build up a good substantial 12-inch square timber and rubble-stone extension of S, say for a length d of 600 feet, we shall find $x = 400$ feet. By such an extension we could, therefore, afford to cut 400 feet off from the south end of the Erie breakwater without any material injury to the security needed in the basin, and gain all of these advantages stated. If d is made 300, x will become 200 feet. In the foregoing formula and the reasons leading to it is the key to a successful and positive plan for the improvement of this harbor, in so far as the wants of commerce immediately centring at Buffalo are concerned. It will be perceived that, so far as the improvement consists merely in extending S, I concur with the plan upon which the late Major Tardy made his estimate, not, however, committing myself to the plan in respect to the *mode* of construction in the *length* of extension he estimated for.

The plan of Major Tardy (referred to in the order calling for my views in case I dissent) I find, in following down the history of this work, is the same as that proposed on the map compiled by Captain (now Brevet Brigadier General) Woodruff, in 1856, which carries on it the plan proposed on a map of a survey under Captain Williams, topographical engineer; as far back as 1839; and it was upon that plan that Major Tardy made his estimate, which plan is shown on map B, and contemplates not only an extension of S by 2,160 feet, but also the construction of an outer breakwater 3,690 feet long, both shown in blue on B, (the breakwater indicated in blue dotted on D.) This outer breakwater, I presume, was intended to cover the harbor so as to give room for refuge in comparatively tranquil water during prevailing storms. From this location for the breakwater it is easy to see that in those storms the proximity of its southern extremity (575 feet) to the extension of the pier, if both were constructed to the extent proposed in that plan, would produce a difficulty precisely similar to that now experienced in consequence of the Erie basin breakwater. The distance, 575 feet, was probably thought, in 1839, to have been ample for the wearing of vessels of the size then engaged in the commerce. But since that time lake vessels have made great strides in dimensions. Now there are many sail vessels on the lakes, little, if any, short of 300 feet in length, including bowsprit, and they will continue to increase in length. Our present large vessels would be in imminent danger in attempting to enter under a furious southwester with a passage of only 575 feet. It should be at least 900 feet, or three times the length of vessel. But an opening so wide as this would cause a tremendous swell in the harbor, under the influence of the prevailing winds and at the very time when the breakwater would be most needed. Besides, in that location of such a breakwater, vessels under those storms would not venture to run down and come up around its northern extremity to obtain a lee under it.

In reading over Captain Williams's report, as well as that of Major Tardy, on this proposed breakwater, I find cheapness of construction the chief argument for its adoption—an argument, in my judgment, of little force, unless the breakwater, when constructed, would answer all purposes.

From the foregoing objections it will be inferred that in the plan of extending the light-house pier, S, 2,160 feet, and constructing that breakwater for an extent of 3,690 feet, as represented in blue on map B, I do not concur. I would not extend S (the present light-house pier) more than 600 feet. For the purpose of refuge, however, a breakwater, B 2, should be constructed, and is seen located in full red on map D, its northern extremity, leaving an opening of 1,500 feet between it and the edge of the shoal where red buoy No. 2 stands, and having a length of about 4,000 feet, and a direction at an angle of 74° with the direction of the most violent storms, and of about 59° with the direction of the prevailing storms, and having an offing of about 2,000 feet from the twenty-feet curve of soundings. The breakwater would stand in about twenty-five feet depth of water. This breakwater to be constructed in the best manner, with timber cribs having compartments filled with rubble stone, its cross-section to rise with a batter to surface of water and then vertically six feet above high water, not with masonry, but with 12-inch square timber superstructure, filled with stone and planked over.

It will be seen by a simple inspection of the map that vessels under the most violent storms could run into the south opening and immediately come to anchor under the lee of this breakwater, or make the harbor; and that they could easily run down under prevailing winds, and wear up between the northern extremity and the shoal, and make the harbor.

IV.—CONDITION OF EXISTING PIERS S AND N.

Having examined these, I am prepared to report upon their condition generally. Captain Tardy's annual report of 1865 sets forth the necessity of protection and repair, and considerable has since been done under his direction to this end; much, however, remains to be done, and as much of the money we have in hand as will be necessary should be applied to this purpose as follows:

1. Protect the whole foot of the lake slope of the stone pavement of the pier S by a close row of piles, and forming a crib-work interior to and connected with this row of piles, and make a superstructure of timber with cross ties, and fill with rubble stone and plank over all. This wooden superstructure to be upon the plan of my "pile pier" to some extent, and to be five feet above the surface of the water and twelve feet wide. This is an improvement upon the mode that was being followed for this protection; what has been done, however, will work into the mode now proposed, and this, if well constructed, will break the force of the sea and prevent it from washing out the stones of the pavement on that side. It will be necessary to put a close row of piles in several places along on the north face of the pier where the old piles are gone and attacks have much dilapidated that pier, and thus prevent further destruction on that side.

2. The outer portion of the stone superstructure of the north pier, N, has been destroyed, and the stones tumbled into the water. This should be rebuilt, not with masonry as before, but with a good construction of timber and rubble stone, with clusters of spring piles at the head. In these two piers, S and N, we have an example of stone superstructure, now, after the lapse of not many years, where masonry, such as it was, has to be sustained and protected by a wooden structure, demonstrating in a striking degree the want of good foresight in building a superstructure with that kind of masonry.

The late Major Tardy gave us an estimate of the cost of a concrete masonry superstructure similar to the construction of S for his proposed extension of that pier, and also for his proposed breakwater, (represented by A and B, map B,) and made it amount to nearly $290 per running foot of piering, making the total cost of both about $1,697,000. We have already seen the results, in the old pier S, of a shell of masonry of stones, not very large, laid in cement, and a heart of a kind of concrete filling. No such masonry can withstand the shocks and washing of the sea, the displacement of the stone by the frost, nor the shocks of vessels against it, so effectually (experience teaches us) as a well-constructed timber and rubble-stone work. The interest on the difference between the first costs of the two modes of construction would far more than keep the latter in repair forever. Your masonry, to withstand such causes of destruction, must be of large, flat cut stone, dovetailed, bonded, dowelled, clamped, and bolted together. I have directed certain measurements and examinations by boring to be made and returned to me by Lieutenant Colonel Harwood, my assistant, which are well under way. When I receive the data I shall be able, and not before, to plan the work and estimate the cost of all that I propose, and shall recommend in this report, for the government to do for this harbor. It cannot amount to as much as estimated by Captain Tardy for the plan he advocated.

V.—CUT THROUGH FROM LAKE TO BUFFALO CREEK FOR A SHIP PASSAGE CALLED "SOUTH PASSAGE.'

In chapter II, of this report, reference is made to jettees, or a work to the southward, with a view of stopping the sand accretion back of, and preventing it from passing around the end of S, and forming a deposit in the mouth of the harbor. I find an old idea now revived in the minds of many intelligent persons who have been long acquainted with the harbor of Buffalo, that a passage once properly opened in the place indicated by C, on map D, would be a decided advantage to the harbor. A canal there, 200 feet wide, with pier or piers projecting into the lake to fifteen feet water, which would require the pier on south side to be 450 feet in length, would allow water from the lake, under the prevailing winds, to flow freely into Buffalo creek, and probably improve the inner, and give more force of outflow to the creek to sweep out the deposit at the mouth of the present harbor; if the canal should be kept open, vessels in the Buffalo trade would realize greater facility for ingress into and egress from the creek. I do not think such a work would be attended with any injurious effect upon the present harbor; on the contrary, it would, for some years to come, arrest the sand and cause the accretion to form back of the south pier of C, until in time it would pass around the end of that pier and form a deposit at the lake mouth of C which would stop that channel unless artificial dredgings be resorted to, just as it is now required to remove the deposit at the mouth of the present harbor. As this is a favorite project with some, and probably would be the subject of memorial to the department unless considered in this report, I have thought it advisable to touch upon the subject, reserving any report of the cost and precise direction of the work until further data be obtained to make the estimate upon. It would not be a very costly work in comparison to the benefit it would be to the interior harbor. Buffalo creek proper, which is now much crowded and restricted in room for vessels to wind, is certainly a question worthy of careful consideration, but whether it is a work to be done by the United States or by the city is another question, upon which I will not undertake herein to express an opinion. It will be time enough for this when the data which has been ordered to be obtained shall be received.

VI.—RECAPITULATION.

It will be seen by one reading of the whole of this report that my views may be summed up as follows:

1. Repair and protect the existing piers S and N.
2. Extend the pier S by 300 to 600 feet.
3. Endeavor to get the State of New York to allow us to remove 200 to 400 feet of the south end of Erie basin breakwater. The extension of S, though we are refused to take from that breakwater, will give great help to the vessels seeking a lee under the pier to make the entrance.
4. Construct the breakwater B^2, on map D, instead of the one estimated for by the late Major Tardy.
5. Make a report in full upon project C when required.

This is the order, in my opinion, in which the improvements of Buffalo harbor should be carried on. As soon as I receive from the department an approval or disapproval of the views expressed in this report, I shall have the data furnished which will enable me to form the plans for the construction and specifications for advertising for proposals. I do not wish to make detail plans, specifications, and estimates, before I know what the department will or will not approve in relation to the general project.

I have the honor to be, very respectfully, your obedient servant,

T. J. CRAM,
Colonel Corps of Engineers, Brevet Major General.

Major General A. A. HUMPHREYS,
Chief Engineer United States Army.

Abstract of amounts full estimate for its entire and permanent completion for each work, and abstract of amounts that can be profitably expended in the next fiscal year, from July 1, 1867, *to June* 30, 1868, *for each work.*

Name of work.		For its entire and permanent completion.	Am'nt that can be profitably exp'd in next fiscal year.
Sea-wall, Buffalo	N. Y.	$46,920 00	$30,000 00
Buffalo harbor	do	(*)	150,000 00
Dunkirk harbor	do	48,584 00	50,000 00
Erie harbor	Penn	33,739 00	50,000 00
Conneaut harbor	Ohio	† 10,638 00	38,000 00
Ashtabula harbor	do		70,000 00
Grand River harbor	do		22,000 00
Cleveland harbor	do	‡ 3,691 00	63,497 00
Black River harbor	do		
Huron harbor	do		25,000 00
Vermillion harbor	do	6,511 00	9,839 84
Sandusky City harbor	do		30,000 00
Sandusky river survey and improvement	do	34,967 00	19,992 40
Toledo harbor	do	(§)	35,435 38
Monroe harbor	Mich		5,724 00
St. Clair flats	do	198,754 00	250,000 00
Saginaw river	do		65,000 00
Ausable harbor	do	19,367 00	50,000 00
St. Mary's river	do	323,983 00	60,000 00

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[*] Cannot be reported until I get all the data for making the working plan and estimate.

[†] This does not include the sum of $35,000, required in addition if the harbor should be improved to allow vessels of fourteen feet draught to enter, as per my report, 1st February, 1867.

[‡] Besides this, there will have to be appropriated $38,622, to make this a harbor for admission and departure of vessels drawing fourteen feet water.

[§] The amount I estimated in my report 1st of February, 1867, to make this a harbor to allow vessels to ente and depart drawing fourteen feet water, was $469,664. No appropriation should be expended until perfec plans can be made, requiring first surveys and examinations.

I certify this to be a true abstract.

T. J. CRAM,
Colonel of Engineers, Brevet Major General.

Abstract exemplifying the commerce to which each work contributes for the fiscal year from July 1, 1866, *to June* 30, 1867.

Name of work.	Number of entrances and clearances, sail and steam vessels.	Total tonnage measurem'nt of all vessels entered and cleared.	Collection district in which the work is located.	Near what fort, light-house, or port of entry the work is situated.	Amo't of revenue collected at the port during the fiscal year as duties on imports.
Sea-wall, Buffalo, N. Y.	....	....	Buffalo Creek, N. Y.	Fort Porter; light-house on pier	....
Buffalo harbor, N. Y.	25,454	12,127,276	Buffalo Creek, N. Y.	Fort Porter; light-house on pier	$554,778 40
Dunkirk harbor, N. Y.	679	452,925	Dunkirk, N. Y.	Light-house on main land, beacon on breakwater	1,557 37
Erie harbor, Penn.	2,119	421,874	Erie, Penn.	Light-house on main land, beacon on pier—range light	21,182 00
Conneaut harbor, Ohio	44	3,836	Cuyahoga, Ohio	Beacon on pier	33 25
Ashtabula harbor, Ohio	151	13,238	Cuyahoga, Ohio	Beacon on pier	....
Grand River harbor, Ohio	59	4,365	Cuyahoga, Ohio	Light-house on main land, beacon on pier	1,102 30
Cleveland harbor, Ohio	6,839	2,690,766	Cuyahoga, Ohio	Light-house on main land, beacon on pier	104,337 48
Black River harbor, Ohio	136	10,068	Cuyahoga, Ohio	Light-house on pier	355 44
Huron harbor, Ohio	*	*	Sandusky, Ohio	Beacon on pier	....
Vermillion harbor, Ohio	76	7,995	Sandusky, Ohio	Beacon on pier	4 50
Sandusky City harbor, Ohio	3,001	312,382	Sandusky, Ohio	Light-house on main land, beacon at entrance	1,446 00
Sandusky river survey and improvement	†	†	†	Light-house at entrance of bay	....
Toledo harbor, Ohio	4,918	1,149,897	Miami, Ohio	Turtle Island light; Cedar Point light, at entrance of bay	33,632 13
Monroe harbor, Mich.	410	20,820	Detroit, Mich.	Light-house on pier	....
St. Clair flats, Mich.	‡	....	Port Huron, Mich.	Light-house and range light	....
Saginaw river, Mich.	3,756	973,445	Port Huron, Mich.	Light-house on main land at entrance of river	5,629 38
Ausable harbor, Mich.	†	†	Port Huron, Mich.	Light-house on Tawas Point, 16 miles off	....
St. Mary's river, Mich.	§	†	Mackinaw, Mich.	River light	....

* No reply from collector. † Not obtainable. ‡ All commerce between upper and lower lakes. § All commerce from and to Lake Superior not obtained.

I certify that this is a true abstract as far as I have been able to obtain.

T. J. CRAM, *Colonel of Engineers, Brevet Major General.*

Abstract of contract for each class of materials or labor for each work.

Name of work.	Name of contractor and what he contracts for.
Sea-wall, Buffalo....N. Y...	Not yet under contract.
Buffalo harbor........do....	Not yet under contract.
Dunkirk harbor ..... .do....	Alex. McDonell, for furnishing wood and stone material, and for doing all work; R. Nelson Gere, all iron materials.
Erie harbor.........Penn..	Brooks & Adams, for all timber; James Loveday, for all iron; Vincent & King, for stone and piles, and for doing all work on piers; Lee & Dunbar, for dredging bars.
Conneaut harbor....Ohio...	Kenneth McKenzie, for all timber and stone, and for doing all work on repairs of old piers; James Loveday, for iron materials.
Ashtabula harbor.....do....	Kenneth McKenzie, for all timber and stone, and for doing all work on repairs of old piers; James Loveday, for iron materials.
Grand River harbor .. do....	J. E. & D. E. Bailey, for piles, stone, spikes, and doing all work; Brooks & Adams, for timber; James Loveday, for iron materials.
Cleveland harbor ....do....	J. E. & D. E. Bailey, for furnishing stone and doing all work; Patrick Smith, for piles; J. Dwight, Palmer & Wright, timber; James Loveday, iron.
Black River harbor ..do....	Not under contract.
Huron harbor.........do....	W. H. Mott, for all work; F. D. Ketchum, stone, spikes, and timber; Brooks & Adams, timber; Jas. Loveday, iron.
Vermillion harbor ....do....	W. Nicoll, for all work; Standart & Richardson, timber; F. D. Ketchum, stone and spikes; James Loveday, iron.
Sandusky City harbor.do....	Thomas Dunbar & Co., for all dredging.
Sandusky river survey and improvement ....Ohio...	Thomas Dunbar & Co., for dredging improvement; surveying not done by contract.
Toledo harbor.........do....	Thomas Dunbar & Co., for all dredging.
Monroe harbor .....Mich...	W. H. Mott, for all work; J. M. Sterling, all timber, iron, spikes, and stone.
St. Clair flats........do....	John Brown, for all work, and furnish all wood materials. Moses Hill, all iron materials for improvement straight ship canal.
Saginaw river ....do....	John Brown & Co., for dredging.
Ausable harbor ....do....	Carkin & Kimball, for all wood and iron materials; — —, work for putting in the piers, stone, and dredging.
St. Mary's river....... do....	John Brown & Co., for dredging middle channel, Lake George.

I certtfy this to be a true abstract.

T. J. CRAM,
Colonel of Engineers, Brevet Major General.

Abstract of contracts for each work, with names of contractors.

Name of work.	Names of contractors.
Sea-wall, Buffalo ...N. Y ..	Not under contract.
Buffalo harbor........do....	Not under contract.
Dunkirk harbor.......do....	Alex. McDonell, Hamilton, C. W.; R. Nelson Gere, Syracuse, N. Y.
Erie harbor ....Penn...	Brooks & Adams, Detroit, Mich.; James Loveday, Cleveland, Ohio; Vincent & King, Erie, Penn.; Lee & Dunbar Buffalo, N. Y.
Conneaut harbor....Ohio...	Kenneth McKenzie, Ashtabula, Ohio; James Loveday, Cleveland, Ohio.
Ashtabula harbor .....do....	Kenneth McKenzie, Ashtabula, Ohio; James Loveday, Cleveland, Ohio.
Grand River harbor ..do....	J. E. & D. E. Bailey, Painsville, Ohio; Brooks & Adams, Detroit, Mich.; James Loveday, Cleveland, Ohio.
Cleveland harbor .....do....	J. E. & D. E. Bailey, Painsville, Ohio; Patrick Smith, J. Dwight, Palmer & Wright, and Jas. Loveday, Cleveland, Ohio.
Black River harbor ..do....	Not under contract.
Huron harbor.........do....	W. H. Mott, Detroit, Mich.; F. D. Ketchum, Huron, Ohio; Brooks & Adams, Detroit, Mich.; James Loveday, Cleveland, Ohio.
Vermillion harbor .....do....	W. Nicoli, Detroit Mich.; Standart & Richardson, Cleveland, Ohio; F. D. Ketchum, Huron, Ohio; Jas. Loveday, Cleveland, Ohio.
Sandusky City harbor.do....	Thomas Dunbar & Co., Toledo, Ohio.
Sandusky river survey and improvement....Ohio...	Do. do.
Toledo harbor ....do....	Do. do.
Monroe harbor ......Mich...	W. H. Mott, Detroit, Mich.; J. M. Sterling, Monroe, Mich.
St. Clair flats ....do....	John Brown, Thorold, C. W.; Moses Hill, Cleveland, Ohio.
Saginaw river ....do....	John Brown & Co., Thorold, C. W.
Ausable harbor........do....	Carkin & Kimball, East Saginaw, Mich.
St. Mary's river.......do....	John Brown & Co., Thorold, C. W.

I certify this to be a true abstract.

T. J. CRAM,
Colonel of Engineers, Brevet Major General.

APPENDIX C.

U. S. ENGINEER OFFICE, OSWEGO, N. Y.,
August 29, 1867.

SIR: I have the honor to transmit herewith my report of progress upon the works of harbor improvement in my charge during the year ending June 30, 1867. I also report, as far as practicable, upon the works placed in my charge this last spring, upon which little has yet been done, partly because the plans have only recently been determined upon, and partly from the obstacles which the provisions of the acts of June 23, 1866, and March 2, 1867, place in the way of executive officers, and which provisions, instead of facilitating the speedy, economical, and proper execution of the works, have, in my opinion, just the opposite effect.

Very respectfully, sir, your obedient servant,

C. E. BLUNT,
Lieutenant Colonel of Engineers, Brevet Colonel U. S. A.

Major General A. A. HUMPHREYS,
Chief Engineer United States Army.

IMPROVING HARBOR OF BURLINGTON, VERMONT.

The appropriation made under this title by the act of March 2, 1867, was $80,000. The appropriation of the previous year was $27,672 20 for extension and repair of breakwater at Burlington, Vermont. A special board of engineers visited Burlington in June, 1867, and recommended the extension northwardly of the present breakwater, in a direction nearly parallel to the shore line, with a rectangular cross section of 30′ width and rising 2′ above extreme high water; the depth at low water along this line being about 30′. An additional length of 1,500′ is desirable, and the estimate of amount needed for completion ($333,442) is based upon this length. The amount now available will, it is hoped, be sufficient to build a length of 450′. The project of the board of engineers having been approved by the engineer department, proposals have been invited and contracts entered into, and it is hoped that some progress can be made in the work during the present season.

It has not been practicable to procure, in time for this report, the exact commercial statistics of Burlington for the last fiscal year, but it is estimated that the quantity of lumber received was about 100,000,000 feet, board measure; the gold value of the principal imports $1,000,000; and the amount of tonnage averaging about 350,000. Burlington is a port of entry, in the district of Vermont, fifty miles distant from Fort Montgomery, New York.

There are two beacon-lights upon the present breakwater, the northern of which must be removed to the extremity of the extension.

If the extension of the breakwater is to be further prosecuted until completed, it is very desirable that the work should go on continuously, and an appropriation of $100,000 could be profitably expended during the year ending June 30, 1869, provided the restrictions imposed by the present law are removed and some discretion allowed the engineer officer in charge. It is believed that these restrictions are entirely inconsistent both with the economical and proper execution of public works of this nature.

Abstracts of proposals and contracts are sent herewith.

IMPROVING HARBOR OF PLATTSBURG, NEW YORK.

The appropriation of $26,000 made for this purpose by the act of March 2, 1867, being based upon the estimate of Brevet Brigadier General Reese, for the *repairs of the breakwater only*, contracts have been made for that purpose, and it is hoped that the work will be well advanced before the close of navigation. It being found upon examination, however, that the width of the renewed superstructure could be somewhat reduced, without disadvantage, so that no new stone would be needed, it is probable that a small balance will remain after these repairs are executed. This balance, with an additional grant, should, it is believed, be applied in the removal by dredging of a shoal lying between the wharves and the breakwater, which is a great obstruction to navigation.

A series of soundings were made by Brevet Major Allen, in January, 1867, and a report with maps sent to the engineer department. In this report dredging was recommended, the estimated cost, (based upon a depth of thirteen feet at low water) being $84,326 50, but it is believed that, upon this basis of dredging contracts made for other harbors this year, the *quantity necessary to be removed* will require an appropriation of only $20,000, besides the balance of $2,000 or $3,000 which may remain of the last one. Plattsburg is a port of entry, in the northern New York district. There are two light-houses on the breakwater. The nearest fort is Montgomery, at Rouse's Point, twenty miles distant.

It has not been practicable to procure this year's commercial statistics, but a good idea of the business of the place, and of the improvement required, is given in the following quotation from a printed petition to Congress, dated February, 1866:

"The harbor of this place is the best harbor of any extent or importance on the west side of the lake, being protected on the west, north, and east by the shores of Cumberland bay, and on the south by the breakwater. As early as 1812, Plattsburg was, and still continues to be, a military post of the general government. The government have erected extensive barracks and quarters for military purposes upon their own ground next south of the wharves and bordering upon the lake. This military post, as early as 1820, was connected with Sackett's harbor, on Lake Ontario, by a military turnpike, with a view to the protection and defence of the frontier.

"The government also, in 1838-9, erected a breakwater 855 feet long by 41 wide, of timber and stone, at a proper distance south of the wharves, to protect the harbor against south winds, which are the prevailing and strongest winds upon the lake, and the only ones to which the harbor is exposed. By the erection of the breakwater this harbor was rendered secure to vessels while loading and unloading at all times.

"The government grounds lie immediately south of the harbor, the banks of which are high and steep, and are composed of sand, loam and clay. The banks between the wharves and the government grounds, owned by individuals, are protected by a crib work of stone and timber; but the banks of the government grounds, being unprotected and exposed to the waters of the lake, have washed away to considerable extent within the last ten years. The materials thus detached from the banks have washed down into the harbor below the breakwater and formed a sand-bar across the channel and in front of the south wharf, and been deposited generally over the entire harbor and along both wharves to such an extent as seriously to interfere with navigation in times of low water.

"The sand-bank amounts to a total obstruction of the channel for 150 feet in front of the south wharf. The depth of water in 1839, when the breakwater was built, was from ten to fifteen feet on the present location of the sand-bank. The average depth of water upon the sand-bank is now but two feet, and during low water in summer and fall the sand-bank is scarcely covered.

"The breakwater seems to have been located upon the assumption that the channel would remain or be kept clear and unobstructed. It will be seen by reference to the maps that the former course of steamboats and vessels, till within a few years, was in a direct line from and to the wharves past the west end of the breakwater. But since the formation of the sand-bank aforesaid which now extends into the harbor 150 feet east of the south wharf, vessels arriving from and departing for the south are compelled to make a circuit around the sand-bank, which is accomplished with danger, difficulty and delay, in dark nights, and with unfavorable winds. The harbor is no less important to the commerce of the lake and no less national in its character at the present time than in 1839, when government built the breakwater. The following items of export from this port during the past season of navigation will give some idea, (though imperfect,) of the extent and amount of exports therefrom, being wholly the productions of this country, to wit:

Iron in blooms and other forms, pounds	9,204,752
Nails, 29,000 kegs, pounds	2,900,000
Starch, 1,786 barrels, 1,753 bags, 230 casks, pounds	789,800
Flour, barrels	7,516
Provender, pounds	1,026,222
Lumber, pieces	2,443,906
Shingles	4,087,000
Barrels of heading	11,448
Barley, pounds	4,201,105
Oats, pounds	4,879,696

"During the season of navigation two large steamers arrive daily at evening, and most of the season after dark, en route for Whitehall and Rouse's Point, and in consequence of the sand-bar their landing and departure are effected with difficulty and delay. During a portion of the past season, for want of water, these boats were compelled to leave passengers and freight, and receive the same at the northern corner of the railroad wharf, and at times were unable to effect a landing at any point. There is also a daily line by steamboat, between this port and Whitehall, from early in the spring till late in the fall. There are four other steamers and two propellers on the lake, whose business is carrying freight and towing canal boats and barges to and from Whitehall and Rouse's Point. These steamers arrive and depart at least four times a week, receiving and discharging freight of various kinds, and each generally have in tow from six to twenty canal boats and barges. There is also a daily ferry by steamboat between Plattsburg and Burlington during the season. This port is the terminus of the Plattsburg and Montreal railroad, which brings to it a large amount of exports to be transported through the lake to market, and conveys back merchandise to persons and places along the line of the road. It is also the terminus of a plank road leading to Clinton prison and up to the Saranac river into the timber and iron regions. The village of Plattsburg contains a population of over four thousand persons, and not only the inhabitants of this village, but the whole country back for about thirty miles, are *wholly* supplied with merchandise, and partly with provisions, through this port. The population thus supplied is about twenty thousand."

An appropriation of $20,000 is asked for the next fiscal year; this sum is believed sufficient for the completion of the improvement. The prevention of further *injury* by the construction of crib work along the shore on the public land is a separate matter; this would probably require $10,000 more.

Abstracts of proposals and contracts are sent herewith.

IMPROVEMENT OF OGDENSBURG HARBOR, NEW YORK.

This harbor was examined in June, 1867, by a special board of engineers, who considered the projects of improvement submitted by Brevet Brigadier General Reese, corps of engineers. These projects embraced the construction of piers for the confinement of the current of the Oswegatchie river, as well as dredging in various portions of the harbor. The report of the board, which was approved by the engineer department, recommended the expenditure of the appropriation ($40,000) in dredging, exclusively, in various portions of the harbor and channels. It is believed that the amount available is sufficient, and no further appropriation would be needed for several years, the rate of deposit not being very rapid. The contract has been made, and it is hoped that considerable work will be done before the close of the present season.

Ogdensburg is a port of entry in the district of Oswegatchie, New York. It has a harbor light. The town is equidistant (120 miles) from two forts, Montgomery, at Rouse's Point, and Ontario, at Oswego.

The commercial statistics of the year could not be obtained in time for this report. The town is the centre of a large and increasing business, which will be greatly facilitated by the dredging proposed.

Abstract of proposals and contracts are sent herewith.

IMPROVEMENT OF OSWEGO HARBOR, NEW YORK.

The operations for this object have been the repair of the United States pier and dredging.

Contracts (which were reported last year) have been made for the materials and labor required to keep the pier in order up to the close of the season of 1868.

The dredging, which was carried on under a per diem contract up to June, 1867, has resulted in opening for vessels a considerable portion of the harbor along the western end of the pier and vicinity.

The contract for dredging under the new appropriation has been made on terms somewhat more favorable than the last, and it is expected that considerable work can be done this season. The amount expended up to June 30, 1867, was for dredging, $29,451 50; materials and labor on pier, $5,517 14; contingencies, $736 56.

As reported last year the repairs of the old pier must be made every year, whenever damages are caused by heavy gales and by the action of ice. The dredging, too, (though more will be done with the available funds than was anticipated,) should be continued. For these objects an additional appropriation of $25,000 is needed for the next fiscal year.

It is believed that should this sum be granted no further dredging will be needed for several years, or until causes steadily in action shall have resulted in a further accumulation of material requiring removal.

But, as the damage to the old wooden pier is constant, an annual expenditure for its repair and re-enforcement will be necessary. This annual expenditure is estimated at $12,000.

A suggestion has been made, by various persons interested, that the present light-house pier should be extended northwardly into the lake some four hundred or five hundred feet, the object being to cut off the reflected action of the waves from the eastward, inside the harbor. This object is undoubtedly desirable, and I should recommend the construction of the suggested pier (which would cost about $50,000) were it not that I think it would be found very much in the way, and possibly have to be removed should the harbor ever be enlarged by the construction of a *new* United States pier further out in the lake, in place of the present one. The harbor accommodations are even now very cramped for the business of the place, and would prove altogether inadequate should that business increase, as it is believed it will, so that a new harbor pier will probably become necessary before many years.

The complete business statistics of the city for the last fiscal year could not be obtained in time for this report; the value of the exports, however, during the period, was $1,079,320.

The place is the centre of a very large commerce by lake, railroad, and canal, principally in grain, breadstuffs, and lumber, and it is important that the harbor should be maintained in adequate condition for this object and as a harbor of refuge.

Oswego is a port of entry. There is a stone light-house on the United States pier, and Fort Ontario is on the east side of the river, within the city limits.

The abstracts of contracts, &c., required by law, accompany this report.

IMPROVEMENT OF LITTLE SODUS HARBOR, NEW YORK.

Contracts were made (and reported) last fall for the improvement needed in this harbor, as far as the first appropriation would permit. Under these contracts work was commenced in the spring, and is still progressing, though not as rapidly as was hoped, owing to delays on the part of the principal contractor, which have not been quite satisfactorily accounted for.

Up to the 30th of June two cribs, each thirty feet in length, had been sunk, and seven others were in progress. A considerable quantity of timber was also on hand.

The dredging-machines had deepened the channel to twelve feet, low water, for a width of about eighty feet and length of about four hundred feet. These operations are still going on; and it is hoped that by the close of the season a length of pier of four hundred and fifty feet will be completed, and a practicable, though narrow, channel dredged throughout to twelve feet at low water.

The project of improvement reported last year contemplated the extension of the west pier to about 1,300 feet in length, the construction of a short east pier, and the dredging of the channel between them. Besides this, it was thought necessary to close the opening, about one thousand feet in length, between the west pier and the shore. This closure is still considered necessary.

The appropriation of $50,000 made last spring will be expended in these operations, and it is estimated that an additional sum of $25,000 will suffice for the entire completion of all that is needed. This completion is, however, not permanent, as the piers are of wood and must decay, and the channel will very probably fill up to a certain extent, but it is not probable that any further expenditures will be necessary for eight or ten years.

The harbor is in the collection district of Oswego, which is the nearest port of entry, (sixteen miles,) and where the nearest light-house and fort (Ontario) are situated. Its business and commerce are now quite important, though great results are anticipated by the inhabitants from the opening of the harbor and the construction of a railroad connecting with the New York Central. There is no doubt of its value as a harbor of refuge.

A new contract for dredging by the yard has been made, and will go into effect upon the close of the previous one. Nothing had been paid out up to June 30, except for contingencies, ($185 28.)

The abstracts of proposals, &c., required by law, are transmitted herewith.

IMPROVEMENT OF BIG SODUS HARBOR, NEW YORK.

Contracts were made and reported last fall for the improvements needed in this harbor, as far as the first appropriation would permit. Under these contracts work was commenced in the spring and is still progressing, though not as rapidly as was hoped, owing to delays on the part of the principal contractor, which have not been quite satisfactorily accounted for.

Up to the 30th of June about 400 feet of the west pier had been rebuilt up to low-water mark, and a considerable quantity of timber for further work had arrived. The dredging machines had cut off the point of the spit, just inside the entrance, down to eight feet depth. These operations are still going on, and it is hoped that by the close of the season a length of pier of 800 feet will be rebuilt and a practicable, though narrow, channel dredged throughout.

The project of improvement reported last year contemplated the rebuilding of the entire west pier, with a head adapted to a beacon light. The sum now available is believed to be sufficient for these and all other objects for the improvement of this harbor, and no further appropriation is asked for. In the course of eight or ten years, however, the pier, being of wood, may need repairs, and further accumulations of materials may require additional dredging.

This harbor is in the collection district of Oswego, which is the nearest port of entry, thirty miles distant, and where the nearest fort (Ontario) is situated. There is a light-house at the entrance.

The business and commerce of the place are now quite insignificant, though great results are anticipated by the inhabitants from the opening of the harbor and the construction of a railroad connecting with the New York Central. There is no doubt of its value as a harbor of refuge.

A new contract for dredging by the yard has been made, and will go into effect upon the close of the previous one. There was expended up to June 30, $2,215, 35 for dredging and $550 58 for contingencies.

Abstract of proposals and contracts are sent herewith.

SURVEY AND EXAMINATION OF PULTNEYVILLE, NEW YORK.

These were made during the month of June, 1867, and a tracing showing the result of the former is transmitted herewith.

There is now no harbor worthy of the name, and, as at other points on the lake, piers and dredging must be resorted to if one is desired. These piers (an east pier 850 feet long and a west pier 900 feet long) would cost $68,238 44, and 32,000 cubic yards of dredging, at fifty cents, $16,000; to which add contingencies of all kinds, $2,761 56; total cost of improvement, $87,000; which might be granted in two consecutive equal appropriations.

The information obtained in relation to this place may be conveniently given in the form of extracts from a report made to me by my assistant, Brevet Major C. J. Allen, captain corps of engineers, and from letters from persons interested.

Major Allen reports: "The village of Pultneyville claims a population of between four hundred and four hundred and fifty. It contains two stores, one hotel, one planing mill, one tannery, (not in operation,) a custom-house, and post office.

"The receipts from customs last year amounted to (in gold) $1,500. About 700,000 feet (board measure) of lumber imported last year, (from the Canadas,) and a few horses. Six vessels, averaging 100 tons burden, are owned in the village. About fifteen vessels (same draught) enter and depart from the port annually. A daily line of steamers touches at the place during the season of pleasure travel, *en route* from Lewiston to Montreal. There is nothing that can strictly be called a harbor. Several small cribs and one long wharf jut out boldly into the lake, and are perfectly inaccessible to boats in anything like a rough sea.

"A small stream, called Salmon creek, I think, sluggish and discolored, and averaging say thirty-five feet in width, extends from the planing mill to the lake, for which distance it is said to be navigable for vessels drawing seven feet of water. Beyond the bridge it extends, perhaps, three or four miles up the country, but has barely water enough to float a fishing smack.

"The banks of the stream are not liable to be washed by freshets, so that no obstructions at the mouth are to be feared from this source. Between the mill and the lake the stream winds through a swamp of muck, sand, gravel, and swamp grass; a very narrow entrance only is left for vessels, a bar having choked up the former entrance, attributable, I think, to sand carried up by northwest winds.

"To form a harbor, then, (there being no natural harbor there,) will require, first, the excavation of all that part contained within the irregular polygon (A, B, C, D, F—see sketch;) and secondly, the construction of two piers or jettees occupying about the position indicated in the drawing."

It is claimed that a railroad is to be run from Canandaigua to Pultneyville conditionally upon these piers being built by the government.

"The nearest place of importance is Palmyra, upon the line of the New York Central railroad. A line of stages is the only means of communication between the two places at present.

"There is a blast furnace within three or four miles of Pultneyville, working ore obtained from beds in that vicinity, and which may be removed to Pultneyville if the harbor is rebuilt.

"Some farming produce is exported, one item of which, some forty thousand bushels of apples annually, may be mentioned. Land sells for about one hundred dollars per acre.'

S. C. Cuyler, esq., United States deputy collector at Pultneyville, writes as follows to my civil assistant, James S. Lawrence, esq.:

"The yearly trade at this port, foreign and domestic, is over $100,000, consisting of grain, lumber, and fruit.

"The arrivals of schooners and steamers were last year eight-five in number; aggregate tonnage 45,000, ranging from twenty ton vessels to one thousand. This, however, is below the average of years.

"Amount of duties paid last year $1,500; would be vastly increased with a harbor.

"Our trade would be increased with a good harbor in various ways. We have an extensive iron-ore bed some five miles from here, where are now located two blast furnaces. Some of their iron has been shipped at this port; more would have been but for the need of a harbor. Those furnaces are now using coal brought from Erie, Pennsylvania. This is the most favorable point to obtain it. One cargo of 315 tons was landed here last week.

"This port would be the terminus of the Northern Central railroad from Baltimore, which is now completed as far as Canandaigua, twenty-eight miles from us. A survey for the construction of said road to this point has already been ordered."

Captain H. N. Throop, general superintendent of the Lake Ontario steamer line, who resides at Pultneyville, writes me as follows:

"Pultneyville has been a port of entry for many years. It is in the collection district of Genesee. I learn from the deputy collector of the port (S. C. Cuyler) that the amount of revenue collected during the fiscal year ending 30th June, 1867, was $1,200, received principally from duty on lumber."

As the shipments from this place for several years past have to a large extent been in small quantities by daily steamer, it is difficult to come at the quantity or value. There have however, been shipped from this place, during a season, 34,000 to 35,000 barrels of fruit, valued at $150,000. Grain, also, has been shipped from this place to a considerable extent.

There are owned and belonging to the place, or port, schooners Rival, say 360 tons, A. Allen, 300 tons, Sylph, 250 tons, J. J. Nile, 175 tons, Union, 60 tons, and William Doran.

The only line of side-wheel American passenger steamboats running on Lake Ontario touch at this place daily, wind and weather allowing a landing at the imperfect harbor.

The amount of imports would be vastly increased at this place by an improvement of the harbor, permitting loaded vessels to enter and discharge; consequently the amount of customs revenue would be increased in proportion.

Near this port are two blast furnaces, requiring harbor facilities for shipping iron and receiving Pennsylvania coal.

There has been expended for harbor improvements at this place, at various times, by private enterprise, an aggregate of $25,000 to $35,000, but always with too much effort to do too much with too little money. The work to a considerable extent has failed to be permanent. As a harbor of refuge, this place is on the line of the largest amount of trade and navigation between Lake Ontario and the western lakes. As stated above, Pultneyville is a port of entry in the collection district of Genesee, New York.

The nearest light-house is Sodus Point, eleven miles, and the nearest fort (Ontario) at Oswego, forty miles.

GENESEE RIVER HARBOR, NEW YORK.

During the year ending June 30, 1867, 864 linear feet of the west pier have been rebuilt, and since that date contracts have been entered into for the completion of this pier, and the construction of the east pier (nearly 2,500 feet long.) The west pier repairs will be finished in 1867, and those of the east pier will, it is expected, be commenced.

No appropriation was made for this harbor in the spring of 1867, it being supposed that the balance then on hand would be sufficient to complete the work. Should there be no failure in the contract for labor on the east pier this expectation may still be realized; but if from any cause this contract should not be fully executed, the failure would probably involve additional expense, and require an additional appropriation.

The unexpended balance August 1, 1867, was $58,570 59.

Charlotte is a port of entry in the district of Genesee; there is a light-house on the west pier. The nearest fort is Ontario, at Oswego.

The commercial statistics for the last year have not been obtained, but the importance of the harbor is sufficiently shown by the fact that it is the port of the flourishing city of Rochester, and also a harbor of refuge.

Abstracts of proposals and contracts are sent herewith.

IMPROVEMENT OF OAK ORCHARD HARBOR, NEW YORK.

The projects for repairing and extending the pier and dredging the channel having been approved, contracts have been made for labor and materials, and it is hoped that something can be done this season.

The appropriation of $87,000, made last March, is believed to be sufficient to complete the improvement desired.

Oak Orchard is a port of entry in the collection district of Genesee, thirty miles west of the nearest light-house, (at Charlotte,) and forty-five east of the nearest fort, (Niagara.)

The business and commerce of the place are now quite insignificant. There is a good depth of water, however, in the creek, and when improved the harbor will be valuable as a harbor of refuge, and its business will probably increase.

Abstracts of contracts and proposals are sent herewith.

IMPROVEMENT OF HARBOR OF OLCOTT, (EIGHTEEN-MILE CREEK,) NEW YORK.

The projects for the construction of piers and dredging in the channel and harbor having been approved, contracts have been made for labor and materials, and it is hoped that something can be done this season.

The estimate for completion of the work is $118,000; an appropriation of $60,000 having been made last March, an additional grant of $58,000 for the next fiscal year is desired.

Olcott is a port of entry in the collection district of Niagara, eighteen miles east of the nearest fort and light-house of the same name.

The business and commerce of the place are at present small, but will probably largely increase when the harbor improvements are complete. The harbor will then also be valuable as a harbor of refuge, which are few in number upon Lake Ontario. Should it be selected as the outlet of the Niagara ship canal it will acquire a great importance.

Abstracts of contracts and proposals are sent herewith.

C. E. BLUNT,
Lieutenant Colonel of Engineers, Brevet Colonel U. S. A.

OSWEGO, N. Y., *August* 29, 1867.

Abstract of proposals and contract for materials and labor for repair of Plattsburg breakwater, 1867.

Names.	White pine timber, 12 by 12 in. sq.	Round white pine timber.	Rag bolts, 1¼ in. in diameter, and 2 feet long.	Construction of breakwater.
	Per l. ft.	*Per l. ft.*	*Per lb.*	*Per r. ft.*
S. Hart and O. J. Jennings	$0 34	$0 17	$0 06	$19 00
Luther Whitney, (contractor for every class)	25	10	6	12 00

Abstract of proposals and contract for improvment of harbor at Ogdensburg—dredging.

Names.	Per cubic yard.								
	Price.	Boulders and coarse gravel.	Sand and mud.	Mud.	Sand.	Muck, clay, sand, gravel, and boulders not over one cubic yard in size.	Gravel.	Boulders.	Sand and coarse gravel.
Clark & Douglass	$0 32								
H. Van Slyck		$0 39	$0 29						
Hiram Sharp		6 50		$0 40	$0 45				
John F. Hosch		40	30						
F. Kiah		4 50		30	40				
J. McDonald and W. W. Wright	27¼								
R. N. Gere	34								
Peter D. Tobie						$0 29¼			
Albert A. Dodge, (contractor)	17								
W. Doty and Cornelius Day	38								
B. F. Wilson and R. Johnson			60				$0 90	$1 50	
Edwin Allen	25								
D. G. Fort and Joseph Owen								50	$0 28

Abstract of proposals and contract for dredging in Oswego harbor, N. Y., in 1867 *and* 1868.

Names.	Price per cubic yard for—								Price per day of ten hours for heavy stone, old timber, wrecks, &c.
	Sand, gravel, &c.	Sand, mud, and fine gravel.	Tearing up and removing old crib and contents, and all stone within 50 feet of pier.	All other stone.	Removing old timber crib-work and contents, and stone over 800 lbs. in weight.	Stone under 800 lbs. in weight.	Old crib-work, and timber and stone.	All materials.	
Thomas J. Strong								$0 68	
Daniel G. Foote and Joseph Owen	$0 39¼								$69 50
Edwin Allen, (contractor)		$0 23	$1 25	$0 50					
James M. Baker		25			$0 99	$0 50			
P D. Tobie		49							$55, or $8 per hour
H. Van Slyck		33							$60 00
A. P. Grant		29	1 00						
R. R. Dodge		24¼					$0 99		
John W. Allen		24					98		
A. R. Wright		49							

Abstract of contract for improvement of Genesee River harbor at Charlotte, N. Y.

	T. Parsons.	Jennings & Hart.	Wm. Burke & Co.	R. Gorsline.
Flatted pine timber, per linear foot	$0 19			
12 by 12 in. square pine timber, per linear foot	26			
Pine plank, per thousand feet	8 75			
Elm plank, per thousand feet	5 00			
Rock elm plank, per thousand feet	35 00			
Round iron, per pound			$0 04.7	
Spikes, per pound			07	
Stone, per cord	6 00			
Labor for construction of sloping cribs, each (west side)				$75 00
Labor for constructing wing on south end of west pier, per lin. ft.				5 00
Labor for repairing breach in west pier, (80 ft. long,) per lin. ft.				3 50
Construction of east pier, per linear foot		$7 70		

Abstract of proposals and contracts for dredging Little Sodus and Big Sodus harbors in 1867 and 1868.

Name.	Little Sodus harbor.	Big Sodus harbor.
	Price per c. yd.	*Price per c. yd.*
Heman Van Slyck	$0 30	$0 35
J. W. P. Allen *	24	24
Charles Doolittle	29	29
R. Nelson Gere	33	33
R. R. Dodge	25½	25½
A. P. Grant	28½	29½
Daniel G. Foot and Joseph Owens	29	29
William J. Baker †	24	24½
Willard Johnson	42	42
Lewis J. Bennett	28	28
Clark & Douglass	28	28
Augustus R. Wright	32	32
Thomas J. Strong and James H. Sherrill	48	48

* Contractor, Big Sodus harbor. † Contractor, Little Sodus harbor.

Abstract of contracts for improvement of harbor at Ollcott, N. Y.

	Thomas Parsons.	Albert A. Dodge.
12 by 12 inch square pine timber, per linear foot	$0 23	
Flatted pine timber, per linear foot	17	
Pine plank per thousand feet, board measure	22 00	
Elm plank per thousand feet, board measure	22 00	
Piles, each	6 25	
Snubbing posts, each	6 00	
Elm tree nails, each	07	
Screw bolts, per pound		$0 06½
Rag or drift bolts, per pound		05½
8-inch wrought spikes		07½
Stone, per cord		
Dredging, per cubic yard		34
Timber, per linear foot		01½
Iron and spikes, per pound		01

Abstract of proposals for improvement of harbor at Olcott, New York.

Names of bidders.	Lumber.															Iron.						Construction and labor.								
	12in. by 12in. sq. pine timber, per lin. ft.	12in. by 12in. sq. pine timber, per M ft., b. m.	Flatted pine timber, per linear foot.	Flatted pine timber, per cubic foot.	Flatted pine timber, per M, b. m.	Flat'd tim. other than pine, per M, b. m. & l. f.	Pine plank, per M, b. m.	Elm plank, per M, b. m.	Piles, per linear foot.	Piles, each.	Snubbing posts, per linear foot.	Snubbing posts, each.	Snubbing posts, per cubic foot.	Elm tree-nails, each.	Elm tree-nails, per M. feet b. m.	Screw bolts, per lb.	Rag or drift bolts, per lb.	Iron washers, per lb.	8-inch wrought spike.	Stone, per cord.	Dredging, per cubic yard.	Per cubic foot of timber.	Per linear foot of timber.	Per M. feet b. m. of timber.	Per linear foot of piles.	Per linear foot of snubbing posts.	Per M. feet b. m. of plank.	Per linear foot of tree-nails	Per lb. of iron and spike.	Per linear foot of pier.
	Cts.		*Cts.*	*Cts.*					*Cts.*		*Cts.*		*Cts.*	*Cts.*		*Cts.*	*Cts.*	*Cts.*	*Cts.*		*Cts.*	*Cts.*	*Cts.*		*Cts.*	*Cts.*		*Cts.*	*Cts.*	
Dwight Keep		$30	C.ti'	s $27	$19 80		$21	$19 00	25		40			6		9	9			$10 00	70			$17	50				5	
H. F. Cadyll and C. B. Morse		35			30 00	$25	30	25 00	45		45			6		13	14		12	12 00	75			15	50	15			5	
Van Wagner & Matthews		34	26				24																							
Charles E. Case, (dead)	18		18				28	28 00	16		30			4		7½	7½		9	7 50	35									$7 00
Thomas Parsons	23		17				22	22 00		$6 25		$6 00		7		9	6		7	7 00										7 50
J. H. Child		26	21.7				24	24 00		4 00		4 00		4																
W. H. Crennell	24		17½				22	23 00		5 00		5 00				10	7		8	7 50										8 00
Clark & Douglass		30			28 00		25	24 00		7 50		6 00		8		10	9		10	15 00	38		10						4	
Harrington & Moore																				8 00			6		20	15	$5	2		
W. W. Wright and others		28			28 00		30	30 00		6 00		10 80			$40	10	7		9	15 00	44			10			10		2	
A. S. Page		30	20				30	28 75		9 00		7 00		6		7½	6		7½	10 00			16						2	
Albert A Dodge	35		18¾				25	24 00		4 00		5 00		5		6¾	5¼		7½	7 95	34		4½						1	
Chas. A. Janolds, (no guarantee)		21				15½c	24	20 00	20		25			3		5¾	5¾		8	7 75	70									9 25
O. P. Lockwood																7	7			9 00										
G. W. Bird																8.6	7⅛		7											
Shaw, Vincent & Co								20 00																						
Charles S. Birdsall																9⅛	9⅛		8											
C. J. De Graw	32		30				40	40 00		12 00		8 00		8						8 00										
William Burke & Co																6.9	5¾		7											
Pratt & Co																6¼	6¼		7											
Biggs & Huntington																7¼	7⅛													
Payne & Pritchards																7¼	7	3¾	7½											
J. D. Cooper						15		18 00			25									7 50			8							
Van Valkenburg & Peterson	28			28			25	15 00	17				28	8		9	6		8	8 50	50	10			18	10	5		4	
W. M. Platt	23		18						22		22			4																
John Hecker																														10 00
Thomas Clement																7	7	6	8											
John F. Parsons																8	7¼													
J. N. Collins & Co																7⅞	6¾		7½											
R. N. Gere		37			37 00		37	37 00	15		50			7		7.8	6.1		7½	2 70 pr	45			13	5				2½	
Lewis J. Bennett	33		18				25	30 00	16		30				60	8	7		7¾	c. yd.			7							
O. J. Jennings	45		28			15	35	35 00		6 00		8 00		10																
Lewis Jones Peck	25		25				30	30 00						5		18	15		12											
M. H. Mills																														8 40
A. P. Grant																					35									
Edwin Allen																					34									

Abstract of proposals for improvement of Genesee River harbor, at Charlotte, New York.

Names of bidders.	Lumber.					Iron.				Stone, per cord.	Labor.			
	Flatted pine timber, per linear foot.	12 in. by 12 in. square timber, per lin. foot.	Pine plank, per M.	Elm plank, per M.	Rock elm, per M, b. m.	Round iron, per lb.	Long screw bolts, per lb.	Rag or drift bolts, p. lb.	Spikes, per lb.		For construction of sloping cribs, each, west side.	For constructing wing on south end of west pier, per linear foot.	For repairing breach in west pier, 80 feet long, per linear foot.	Construction of east pier, per linear foot.
	Cts.	*Cts.*				*Cts.*	*Cts.*	*C:s.*	*Cts.*					
W. H. Crennell	17	22	$22 00	$21	$25	....	....	....	....	......	......	......	......	....
W. J. Pace	16	20	20 00	20	30	....	....	....	....	......	......	......	......	....
T. Parsons	19	26	8 75	5	35	5¼	....	....	7	$6 00	$75 00	$5 00	$3 80	$8 35
H. H. Coats	17	24	28 00	25	25	....	....	....	....	......	......	......	......	....
Jennings & Hart	16	22	27 00	21	17	....	....	....	....	......	......	......	......	7 70
R. G. Briggs	18	28	26 00	28	40	....	....	....	....	......	......	......	......	8 00
J. Caldwell	16	22	30 00	20	25	....	....	....	....	......	......	......	......	....
W. Rankin	18	24	24 00	22	24	....	12	8	....	7 00	......	300 ft.	& $9 for	$7 for 1st rbal'nce.
J. Peterson	16	21	22 00	20	26	....	....	....	....	......	......	......	......	8 94
A. McAllister	17	22	22 00	20	24	....	....	....	....	......	......	......	......	8 50
George Hardison	....	....	......	....	....	....	....	....	....	......	......	......	......	10 00
T. J. Strong	18	34	39 00	38	35	....	....	....	....	......	......	......	......	....
J. F. Bebee	18	33	25 00	30	60	....	....	....	....	......	......	......	......	....
M. H. Mills	19	24	25 00	22	30	....	....	....	....	......	......	......	......	....
John T. Parsons	....	....	......	....	....	....	7½	7	....	......	......	......	......	....
Lewis J. Bennett	....	....	......	....	....	6¾	7¾	....	....	8 00	......	......	......	....
Jacob Baun	....	....	......	....	....	....	....	....	....	6 25	......	......	......	....
George Tyler	....	....	......	....	....	5¼	....	....	7	6 70	......	......	......	....
Pratt & Co.	....	....	......	....	....	5	....	....	7	......	......	......	......	....
William Burke & Co.	....	....	......	....	....	4. 7	....	....	7	......	......	......	......	....
A. S. Page	....	....	......	....	....	5¾	....	....	8	7 00	......	......	......	....
C. B. Benson	....	....	......	....	....	6¼	....	....	8½	10 00	......	......	......	....
Dey & Ellis	....	....	......	....	....	....	....	....	....	7 00	......	......	......	....
D. P. Fairchild	....	....	......	....	....	6½	....	....	8½	9 50	......	......	......	....
James Cochrane	....	....	......	....	....	....	....	....	....	6 00	......	......	......	....
R. Gorsline	....	....	......	....	....	5¼	....	....	7¼	6 50	75 00	5 00	3 50	....
A. F. Parsons	....	....	......	....	....	5½	...	....	7¼	6 80	......	......	......	....
P. C. Dowling	....	....	......	....	....	....	....	....	....	6 50	......	......	......	....
Robert McIntyre	....	....	......	....	....	....	....	....	....	11 00	......	......	......	....
W. S. Grant, Lynn	....	....	......	....	....	9	....	....	12	6 20	......	......	......	....
J. N. Collins & Co	....	....	......	....	....	5½	....	....	8	......	......	......	......	....
C. J. Degraw	....	....	......	....	....	10	....	....	12	8 00	......	......	......	....
D. Wagner	....	....	......	....	....	....	....	....	....	6 75	......	......	......	....
Charles E. Case	....	....	......	....	....	6	....	....	9	......	......	......	......	....
Paine & Pritchard	....	....	......	....	....	....	7½	7	7¼	......	......	......	......	....
R. N. Gere	....	....	......	....	....	4. 6	....	....	7½	......	......	......	......	....

Abstract of contract for material and labor for constructing the Burlington breakwater.

Names of contractors.		Hemlock timber, 12 by 12 in. square, per lin. ft.	Pine timber, 12 by 12 in. square, per lin. ft.	3-inch pine plank, per M feet b. m.	3-inch hemlock plank, per M feet b. m.	Tree-nails, each.	8-inch wrought spikes, per lb.	Rag bolts, per lb.	Stone, per cubic yard.	Construction per M ft. b. m. of timber and lumber used.
C. J. Degraw	timber	$0 14	$0 17	$30 00	$18 00	$0 06	......	......	......	......
R. N. Gere	iron	......	......	......	......	......	$0 06. 8	$0 04. 95	......	......
Luther Whitney	stone	......	......	......	......	......	......	......	$1 00	......
Jennings & Hart	labor	......	......	......	......	......	......	......	......	$4 37½

Abstract of proposals for materials and labor for constructing the Burlington breakwater.

Names of bidders.	Hemlock timber, 12 by 12 in. square, per lin. ft.	Pine timber, 12 by 12 in. square, per lin. ft.	For portion of pine timber, delivered by Oct. 1, 1867, per lin. ft.	For portion of hemlock timber, delivered by Oct. 1, 1867, per lin. ft.	3-inch pine plank, per M b. m.	3-inch hemlock plank, per M b. m.	Tree-nails, each.	8-inch wrought spikes, per lb.	Rag bolts, per lb.	Stone, per cubic yard.	Construction per cubic or lin. foot of timber.	Construction per M b. m. of plank.	Construction per linear foot of breakwater.	Construction per sq. foot of one side of breakwater, (19,200 feet.)	Construction per M b. m. of timber and lumber used.	Construction per M b. m. of timber.
Walter Doty and C. Daly	$0 20	$0 24½	$0 28	$0 23	$27 00	$20 00	$0 06	$0 08	$0 07½	$1 00	$0 08	$5 00				
C. J. Degraw, (contractor for timber)	14	17			30 00	18 00	6	10	10	1 50			$38 00			
George P. Woods	14	21	22	15	25 00	16 00	10	12	10	1 25				$0 50		
L. B. Platt	16	24½			30 00	17 00	8	10	9	1 20				60		
Thomas J. Strong & Sherrill	25	40			40 00	23 00	4	8½	9	1 70					$7 00	
R. N. Gere, (contractor for iron)	26¼	36. 12			23 00	15 50	6	6. 8	4. 95	2 70					9 50	
Benjamin H. Hine	14	21			30 00	20 00				1 30						
Wright, Potter & Hubbard	16	23			30 00	20 00	12	9	8	1 40		2 00				$4 75
Luther Whitney, (contractor for stone)	15	25			25 00	20 00	6	10	8	1 00	10	3 00				
Jennings & Hart, (contractors for labor)	19	23			22 00	19 00	7	8½	6¼	1 21					4 37½	
A. Martin	15	25			35 00	25 00										
A. Chapman	18	22½														

Abstract of contracts for improving Oak Orchard harbor, New York.

Names.	Lumber.							Iron.					Construction and labor.	
	Square pine timber, per lin. ft.	Flatted pine timber, per lin. ft.	Oak piles, each.	Snubbing posts, each.	Elm tree-nails, each.	Pine plank, per M b. m.	Elm plank, per M b. m.	Screw bolts, with 1¼-in. nuts, per lb.	Rag or drift bolts, per lb.	8-inch wrought spikes, per lb.	Stone, per cord.	Dredging, per cub. yard.	Per linear foot of timber.	Per lb. of iron rods and spikes.
C. A. Harrington and C. H. Moore, contractors for stone											$6 47			
Albert A. Dodge, contractor for iron and construction								$0 06¾	$0 05½	$0 07½			$0 03½	$0 01
Thomas Parsons, contractor for timber	$0 26	$0 17	$6 25	$6 00	$0 07	$23 00	$22 50							
Edwin Allen, contractor for dredging												$0 29		

Abstract of proposals for materials and labor for improvement of Oak Orchard harbor, New York.

	Lumber.													Iron.							Labor.									
Names.	Square pine timber, per linear foot.	Square pine timber, per M b. m.	Flatted pine timber, per linear foot.	Flatted pine timber, per M b. m.	Oak piles, per lin. foot.	Oak piles, each.	Snubbing posts, per lin. foot.	Snubbing posts, each.	Elm-tree nails, each.	Elm tree-nails, per M b. m.	Stringers, cross-ties, and snub'g posts, per cub. ft.	Pine planks, per M b. m.	Elm planks, per M b. m.	Screw bolts, with 1¼-in. nuts, per lb.	Rag or drift bolts, p. lb.	Iron rods, per lb.	Cast-iron washers, p. lb.	8-inch wrought spikes, per lb.	Stone, per cord.	Dredging, per cubic yard.	Per cubic foot of timber.	Per linear foot of timber.	Per M of timber, b. m.	Per M of plank, b. m.	Per lin. foot of snubbing posts.	Per linear foot of piles.	Iron rods and spikes, per lb.	Rag bolts, per lb.	Per linear foot of pier, (construction.)	Per lin. foot of tree-nails.
	Cts.		Cts.		Cts.		Cts.		Cts.		Cts.			Cts.	Cts.	Cts.	Cts.	Cts.		Cts.	Cts.	Cts.			Cts.	Cts.	Cts.	Cts.		Ct.
Charles S. Birdsall														10	10			8												
W. N. Platt	23		18		22		22		4																					
William Burke & Co														6.9	5½			7												
Van Valkenburg & Peterson					17		17		8		28	$25 00	$15 00		6	9		8	$8 50	50	10			$5	10	17	4	3		
Payne & Pritchard														7¾	7		3¾	7½												
Thomas Clement														7	7		6	8												
John T. Parsons														7¾	7½															
Charles J. Degraw	32		30			$12 00		$8	8			40 00	40 00						8 00											
Pratt & Co.														6¼	6¼			7												
Briggs & Huntington														7¼	7¼															
J. N. Collins & Co														7¾	6¾			7½												
G. W. Bird														8¼	7¼			7½												
A. S. Page	20		16			9 00		7	6			24 00	23 00	7½	6			7¼	10 00			16					2			
John Heckler																													$10 00	
W. W. Wright and others				$28		6 00		10		$40		30 00	30 00	10	7			9	15 00					10			2			
C. A. Huntington and C. H. Moore	30		23			3 00		4	4			22 00	20 00						6 47			6		5	15	20	2			1
R. N. Gere		$37		37	15		50		7			37 00	37 00	7.8	6.1			7½	2 75 per yd	45			$13	13		25	2¼			
A. Clarke and W. H. Douglass		30		28		7 50		6	8			30 00	24 00	10	9			10	16 00	38		10					4		8 00	
J. H. Childs	26		21.7			4 00		4	4			24 00	24 00																	
Albert A. Dodge	35		18¼			4 00		5	5			27 20	26 40	6¾	5¼			7½	7 20	29		3¼					1			
Lewis Jones Peck	25		25						5			30 00	30 00	18	15			12		80										
H. F. Cadyll and H. B. Moore		35		30	45		45		6			30 00	25 00	13	14			12	14 00	34				18	15	50	5			
Lewis J. Bennett	33		18		16			3	6			25 00	30 00	8	7			7¾		34		7								
Charles E. Case, (died)	18		18		16			3	4			28 00	28 00	7¼	7¼			7		35									7 00	
Thomas Parsons	26		17			6 25		6	7			23 00	22 50	9	6			7	7 00										7 50	
M. H. Mills																													8 40	
Edwin Allen																				29										
John W. P. Allen																				29										
A. P. Grant																				29										

C 1.

OSWEGO, NEW YORK,
June 20, 1867.

SIR: By direction of General Bache, I have the honor to transmit herewith the record of proceedings of the board of engineers, which convened in obedience to Engineer Order No. 50, at Ogdensburg, New York, on the 19th instant, for the consideration of plans of improvement of that harbor.

Very respectfully, sir, your obedient servant,

C. E. BLUNT,
Lieut. Col. Engineers, Bvt. Col. U. S. A.,
and junior member of board.

Major General A. A. HUMPHREYS,
Chief of Engineers, Washington City.

In pursuance of Engineer Order No. 50, dated June 15, 1867, convening a board of engineers composed of Brevet Brigadier General Hartman Bache, colonel of engineers; Brevet Brigadier General George Thom, lieutenant colonel of engineers; Brevet Colonel C. E. Blunt, lieutenant colonel of engineers, the board assembled at Ogdensburg, New York, on Tuesday, the 18th of June, 1867, upon the call of its president, "for the purpose of considering and reporting a plan for the improvement of the harbor of Ogdensburg."

Present—all its members.

The board made a partial examination of the harbor, and afterwards adjourned until Wednesday, the 19th of June, at 8 o'clock a. m.

Pursuant to adjournment, the board met at 8 o'clock a. m. on Wednesday, the 19th of June.

Present—all its members.

The board completed the examination of the harbor, after which all the information in the possession of Brevet Colonel Blunt was laid by him before the board, including the following papers, viz:

1. Map of the village, harbor of Ogdensburg, by John W. Tate, civil engineer, 1846.
2. Map of Ogdensburg, "showing the termini, &c.," on a scale of 400 feet to 1 inch, dated February, 1852.
3. Report of Brevet Brigadier General C. B. Reese, captain of engineers, to the engineer department, upon the improvement of the harbor of Ogdensburg, dated November 7, 1866, with accompanying map.

After a full discussion of the subject before the board it was

Resolved, That, in the opinion of the board, the improvement of the harbor of Ogdensburg should be confined, for the present at least, to dredging the selected channels and removing therefrom all boulders, &c., to a depth sufficient for the purposes of trade, and that it will be time enough, in case the channels so deepened be not permanent, to construct piers or dikes, which, in consequence of the complications naturally belonging to the case, in addition to the necessity of maintaining two outlets from Oswegatchie river to the deep water of the St. Lawrence, should only be resorted to as the last alternative.

The business for which the board assembled being completed it was adjourned *sine die*.

HARTMAN BACHE,
Colonel Engineers, Brevet Brigadier General.
GEO. THOM,
Lieut. Col. Engineers, Brevet Brigadier General.
CHAS. E. BLUNT,
Lieut. Col. Engineers, Brevet Colonel.

C 2.

FORT MONROE, VIRGINIA,
February 6, 1867.

GENERAL: In compliance with the instructions contained in your letter of December 15, 1866, requiring an examination of the harbor of Plattsburg, New York, and estimate of cost necessary to remove a shoal said to exist between the breakwater and the main land, "if necessary for the use of the harbor as a harbor of refuge," I have the honor to state that the examination has been made by my assistant, Brevet Major C. J. Allen, corps of engineers, and a copy of his report to me, with map, is herewith transmitted.

By an examination of the map, it will be seen that the harbor, though much contracted by deposits formed since the construction of the breakwater, can still be used as a *harbor of refuge* for vessels drawing fifteen feet of water. The shoals formed between the breakwater and wharf heads, and due no doubt to the existence of the breakwater itself as well as the wharves, have materially obstructed the use of the harbor for even light-draught vessels discharging or taking cargoes at this port.

To remove these shoals and secure a depth of water *generally* that existed as shown on the map of 1844, giving a depth of say nine feet at the wharf heads, will require the removal of 25,000 cubis yards of deposit, which, estimated at fifty cents per cubic yard, will cost $12,500. An outlay of this amount of money, in the manner suggested, would, it is thought, make the harbor what it should be for the commercial interests of the place.

But it is understood that the department desires to improve the harbor as a harbor of refuge only. With this view I would respectfully recommend that the area of the harbor covered by the breakwater, and contained between it and the blue line shown on the map, be dredged to give a depth of eleven feet of water, to afford additional room for vessels of the largest class likely to enter this port. This will require 16,000 cubic yards of dredging, which, estimated at fifty cents per cubic yard, will cost $8,000. This estimate is based on the supposition that a dredge can be procured on Lake Champlain, or that one can be taken into the lake from elsewhere, say through the Champlain canal. After having informed myself on these points I will notify the department.

I am, very respectfully, your obedient servant,

C. B. REESE,
Brevet Brigadier General and Captain of Engineers.

Brevet Major General A. A. HUMPHREYS,
Chief of Engineers U. S. A., Washington, D. C.

FORT MONTGOMERY,
Rouse's Point, N. Y., January 30, 1867.

GENERAL: I have the honor to submit the following in regard to the harbor of Plattsburg, New York. The important part of the harbor, as will be seen by the tracing here forwarded, lies in the immediate vicinity of the breakwater and wharves. This I found considerably filled up by deposits of mud, sand, &c., forming, in several cases, bars which seriously obstruct the navigation of the harbor for vessels of from six to seven feet draught.

I think that, from the natural formation of the harbor, the deposits would be likely to increase steadily, though not at the rate it has since the erection of the present breakwater. The harbor is partially land-locked, with a semicircular sweep from Cumberland Head around to the mouth of the Saranac river, which latter empties into the bay a little to the north of the railroad wharf. The winds from the south, southeast, and east, force the waters of the lake up into this bay around the north and south ends of the breakwater. This body of water is in time thrown back by the north beach, losing its velocity, and resulting in a deposit.

The Saranac river brings down in its course a considerable amount of earth, and large quantities of saw-dust from the various saw-mills situated upon its banks and worked by the power of the stream. The current of the river, meeting that of the lake, forms eddies and counter currents, and causes the mud and saw-dust deposits in the immediate vicinity of the railroad wharf.

The waters of the lake, forced up by the wind, impinge against the breakwater on the sea-side, and seem to separate into two bodies; one passing around the north end of the structure into the harbor formed by the breakwater and the wharves, and the other passing around the south end and into the harbor.

These bodies of water encounter each other in the immediate vicinity of the docks, and also impinge against the wharves, losing their velocities and allowing the earth brought up by them to fall to the bottom. Much of the sediment is, I think, carried up from the various islands situated south of Plattsburg, but I think that the greater part is washed from the banks of the government reservation situated south of the entrance to the harbor. Under heavy south and southeast winds the water is forced up against this shore, and, following the course of the shore line, is carried into the harbor. The gravel occasionally met with on the bars around the wharves is, I think, brought up by the in-shore ice, as it moves up in the spring, and which, upon the melting of the ice, falls to the bottom.

The present breakwater, from its position, not only greatly contracts the harbor, but is, I think, one cause of the shoal having formed so rapidly. A location further seaward, parallel to its present position, and an extension north and south, would seem to be the more desirable.

The remedies, in the order of their importance, are, I think, first, dredging out the shoals; second, protecting a portion, at least, of the shore to the south, by a slight revetment of crib-work.

In regard to the depth of water necessary, merchants and vessel owners are of opinion that from seven to eight feet, at most, of water will be ample for the largest vessels that now enter the harbor. This depth can be attained by a small outlay of money.

I quote a portion of your letter of December 18, ordering an examination of the harbor: "To carry out the wishes of the department, I desire you to make such examination as you can of the harbor, and indicate on the tracing sent herewith the depth of water on the shoal and its extent, and estimate the number of cubic yards that will have to be excavated to give a depth of thirteen feet water."

I was obliged to reject the map of 1844 sent me, as the harbor has undergone such changes, both natural and artificial, that an entirely new survey was needed. Thirteen feet being stated in your letter to be the requisite depth of water, all that portion under the necessary course of vessels not having this depth must be considered shoal. The red lines on the tracing bound the portion to be excavated; the outer line showing the present thirteen-foot line.

The southerly portion of this shoal is narrower than that to the north, but a greater depth of excavation is requisite. Immediately in front of the wharves are shoals of considerable magnitude. Were a depth of water required here simply to facilitate navigation, as it now is, the cost of excavation would be trifling in comparison with the amount required to give a depth of thirteen feet. To give a depth of thirteen feet then, requires the removal of 168,653 cubic yards, at fifty cents = $84,326 50.

This examination was attended with many difficulties. A great portion of the time the thermometer ranged from 8 to 20° below zero, with heavy wind and snow. The severe cold rendered it impossible, in many cases, to use the instrument when it was important to do so. Knowing your anxiety to get your report in immediately, I did not delay further, but made up my map from what I had taken thus far. The soundings were all obtained by cutting through the ice and dropping the lead.

Very respectfully, your obedient servant,

CHAS. J. ALLEN,
Brevet Major U. S. A., First Lieutenant Corps of Engineers.

Brevet Brigadier General C. B. REESE,
Captain Corps of Engineers.

C 3.

BURLINGTON, VERMONT,
June 15, 1867.

SIR: By direction of General Bache, I respectfully transmit herewith the record of proceedings of the special board of engineers, which met here to-day in obedience to Engineer Order No. 43, to consider the subject of Burlington breakwater. The map or tracing mentioned therein, and which I received from the engineer department, is also enclosed. The red line marked upon it "B B," indicates nearly the direction spoken of in the record.

Very respectfully, sir, your obedient servant,

C. E. BLUNT,
Lieut. Col. Engineers, Brevet Colonel, junior member of board.

General A. A. HUMPHREYS,
Chief of Engineers, Washington City.

In pursuance of Engineer Order No. 43, dated June 6, 1867, convening a board of engineers composed of Brevet Brigadier General Hartman Bache, colonel of engineers; Brevet Brigadier General George Thom, lieutenant colonel of engineers; Brevet Colonel C. E. Blunt, lieutenant colonel of engineers, the board assembled at Burlington, Vermont, on Saturday, June 15, 1867, upon the call of its president, for the determination of the position of the breakwater for the protection of the harbor of Burlington, Vermont, and the mode of its construction.

Present, all the members.

All the information in the possession of Brevet Colonel Blunt was laid before the board, including the following papers, viz:

1. Copy of a survey made by Brevet Brigadier General C. B. Reese, captain of engineers, dated 1866, showing the position of the breakwater proposed by him.
2. A study of proposed crib for Burlington breakwater, with plans, elevation and section, made by Brevet Colonel C. E. Blunt, lieutenant colonel of engineers.

After a full discussion of the subjects before the board, it was

Resolved, That the position of the breakwater shall be from the north end of the old breakwater, on a line, in about 29 feet of water, parallel with the general direction of the shore, until it meets a line drawn from about the middle of the wharfage to Rock Point. That the mode of construction of the breakwater shall be by crib-work, loaded with stone, the cross-section of which shall be rectangular, with a base of thirty feet and a height of forty feet.

There being no further business before the board, it adjourned *sine die.*

HARTMAN BACHE,
Col. Engineers, Brevet Brigadier General.
GEO. THOM,
Lieut. Col. Engineers, Brevet Brigadier General.
CHAS. E. BLUNT,
Lieut. Col. Engineers, Brevet Colonel U. S. A.

C 4.

ENGINEER DEPARTMENT,
Washington, February 19, 1867.

SIR: I respectfully return herewith the letter of Hon. Z. Chandler, chairman Committee on Commerce United States Senate, enclosing form of a joint resolution in relation to increasing depth of harbors on the lakes to fourteen feet, &c., referred to this department for report, and have the honor to submit the following:

As no communications had been made to this department from the officers in charge of the lake harbor improvements, nor from other sources, showing an imperative necessity for increasing the depth of the harbors so as to admit of fourteen feet draught, the attention of those officers was directed to the subject upon the receipt of the resolution, and an immediate report was called for. These reports have been received. The harbors are planned for vessels drawing twelve feet, although some now admit vessels of a greater draught.

The economy and security of lake navigation would be materially enhanced by increasing the size and draught of vessels engaged therein; and it has always been foreseen that increased depths would be demanded from time to time by the growing wants of lake commerce. It is not necessary that all the harbors should be equally deep; it will be sufficient for the present that an increased depth should be secured for those where the greatest amount of shipping enters, either for cargo or for safety, and that the channels of the rivers connecting the lakes should be of corresponding depth.

The wants of commerce would be met by deepening the following harbors and channels so as to give a depth of fifteen feet at the lowest stage known. This would secure a depth of sixteen feet at average low water, and admit at all times vessels of fourteen feet draught. The estimates of cost are in addition to the estimates for completion, submitted in previous reports:

Lake Michigan.—1. For Chicago, $25,000; 2. For Milwaukee, $47,000; 3. For Manitowoc, $50,000; 4. Aux Becs Scies, $65,000; 5. Grand Haven, already asked for; 6. St. Joseph, already asked for.

Lake Superior.—1. For Superior City, $50,000; 2. For Marquette, already asked for; 3. For Sault St. Marie canal, a new canal and locks must be built, and when completed the present canal and locks must be enlarged. Not estimated for.

Connection of Lake Huron and Lake Superior.—1. For St. Mary's river, $100,000.

Connection of Lake Huron and Lake Erie.—1. For St. Clair Flats, $40,000.

Lake Erie.—1. For Toledo, $550,000; 2. For Cleveland, $130,000; 3. For Erie, $92,000; 4. For Buffalo, already estimated for.

Lake Ontario.—1. For Genesee river, $25,000; For Oswego, $25,000.

Total for the lakes exclusive of the cost of Sault St. Marie canal, $1,200,000.

It is to be remarked that until the new canal and locks at Sault St. Marie, with the increased depth, are built, it will be unnecessary to deepen the St. Mary's river and the harbors on Lake Superior.

Omitting Lake Superior and St. Mary's river, the estimated cost is $1,050,000.

The reports of Brevet Brigadier General T. J. Cram, Lieutenant Colonel C. E. Blunt, and Major J. B. Wheeler, are transmitted herewith.

Very respectfully, your obedient servant,

A. A. HUMPHREYS,
Brigadier General and Chief Engineer.

Hon. E. M. STANTON,
Secretary of War.

Report upon the question of increasing the depth of lake harbors so as to admit vessels of fourteen feet draught, by T. J. Cram, colonel corps engineers, Brevet Brigadier General United States Army; made in accordance with instructions from the engineer department, of February 1, 1867.

FEBRUARY 14, 1867.

I. Taking the harbors of Chicago and Buffalo for the terminal points of lake navigation, as the commerce of the lakes now stands, the depth of water which it is practicable to give and maintain at these two harbors should, in my judgment, rule for the important intermediate harbors and channels in the chain of navigable water, including the St. Clair flats, as also rule the improvements of St. Mary's river, its ship canal into Lake Superior, and the depth that is in contemplation to give on the mitre-sill of a ship canal, intended by the people of the great northwest, to be made on the American side around the Falls of Niagara. To dig out the intermediate harbors between Chicago and Buffalo, and extend their piers so as to gain depth to fourteen feet, without first carefully considering the foregoing named improvements, would, in my opinion, be a wrong beginning.

The question arises as to which are the important intermediate harbors, or works, between Chicago and Buffalo. Their importance rests upon consideration of the magnitude, present and prospective, of the commerce and of the wants of the general navigation for refuge where the harbors are. Upon these considerations, as a stand-point, I have no difficulty in determining, in my own mind, the works within my superintendency which are entitled to receive the increased depth. They are: Erie, Pennsylvania, Cleveland, Ohio, Toledo, Ohio, St. Clair flats, St. Mary's river (in certain places) and St. Mary's canal. Although the St. Mary's river and its canal are not located exactly intermediate, they nevertheless are of too much importance, in view of the future immense magnitude of the Lake Superior commerce in its relation to the general lake trade, to be overlooked in the project now under consideration. The other harbors within my superintendency I would leave with twelve feet water wherever it is practicable to obtain and maintain that depth, the estimates for which are already in the engineer department.

The phrase "to admit vessels of fourteen feet draught" is indefinite, and this very indefiniteness will probably lead to discrepancies in the estimates of the several officers charged with estimating the cost of deepening the channels at the harbors in the various lakes. Shall the estimate be based upon a depth of fourteen feet below high stage during the season of navigation? or medium stage? or average low stage? The lowest stage of water occurring in the season of navigation is the one whose surface should be taken as the plane of reference in assigning the depth for the improvement.

Now, it is of the highest importance that the terminal points, Chicago and Buffalo, should have water of sufficient depth at all times of blows, so prevalent here, that vessels can enter and depart with their cargoes without detention, or risk for want of depth or width of water way. For this purpose, were it left to my judgment, I should make the phrase to mean fourteen feet below the lowest known stage. This would insure fifteen feet at average low water, and I would assign thirteen feet below the lowest known stage in the season of navigation, for the depth at Erie, Cleveland, Toledo, St. Clair flats, and the places in the St. Mary's river and on the mitre-sill of its ship canal, which with the upper part of that river connects the navigation with Lake Superior. This would insure fourteen feet at average low water. In regard to the estimates for improving the Chicago and Buffalo harbors to the required depth, these not being within my superintendency, I doubt not will be made by the officers respectively in charge of them. Now, it must not be inferred that I advance the opinion that when the Chicago harbor is completed and completely dredged out by artificial means, the force of the outflow of its river, alone, will keep it clear to the depth proposed, especially as the city is striving to turn the course of that river into the Illinois river and to draw the waters of the lake through in the same direction. Nor do I know that the outflow at Buffalo will alone be sufficient to keep that harbor clear to the depth proposed.

The commerce, however, has already attained to such a magnitude at these points, as to justify artificial aids to the force of the outflow in successive dredgings to maintain depths in all ordinary times of fourteen feet below the lowest stage that occurs in the season of navigation.

II.—ESTIMATES OF COSTS OF THE PROPOSED DEEPENING AND MODIFICATIONS OF ERIE HARBOR, PENNSYLVANIA.

The estimate for dredging the outer bar to obtain twelve feet, and for extending the north pier, has already been made in my annual report of 1865, and the sum appropriated to the amount of $36,961. I make the estimate of the cost of the additional items, viz., outer dredging, inner dredging, further extension of pier, and the restoration of the old interior north breakwater, to amount to $54,666; therefore, the cost of deepening, &c., to the standard proposed, is $91,627.

1. *Cleveland harbor, Ohio.*—In my annual report of 1865 I estimated for extending both piers of this harbor, and thereby increasing its capacity, at a cost of $59,806. I estimate the additional work, viz., dredging in order to deepen it, and a further extension of each pier by about 110 feet to preserve the channel, to cost $38,622. This added to the foregoing will bring the total cost, in order to bring this important work to the standard proposed, at $98,428.

2. *Toledo harbor, mouth of Maumee river, in the Maumee bay, Ohio.*—The amount appropriated by Congress last session was $20,000, I make the amount required to pay for dredging the channel, in addition to that contemplated with the above sum, to a greater width and depth, straight out, in a northeasterly direction from fifteen feet water in the river, with a channel width of 300 feet to sufficiently deep water in the lake, dumping in the north channel so as to dam that, and force all the water through the new channel, to be $449,664; this added to the $20,000, will bring the improvement to the standard proposed, and to cost $469,664.

3. *St. Clair flats, Michigan.*—At its last session Congress appropriated for this $80,000. In my "revised report" of December 10, 1866, I estimated the cost of improving the existing crooked channel to as high a degree as the case admitted, at $383,293, and no modification of the plan can be made if we follow this old channel; and as it contemplates thirteen and a half feet of water, it will be seen that the above sum is the estimated cost of bringing the work to the contemplated standard. But, in the same report I presented reasons for making the improvement by a direct short ship canal across the flat, in preference to expending any more money for dredging the existing channel; and I estimated the cost of the canal at thirteen feet deep at lowest stage, 300 feet wide between banks, and the banks to be revetted and raised vertically five feet above the water, and to be fifty-eight feet wide on top, and to bear trees, at the total sum

of $428,754. Hence it will be seen that this is the estimate of the cost of this mode of improving the navigation to the standard depth contemplated without other modifications.

4. *St. Mary's river, Michigan.*—Congress appropriated at its last session for this the sum of $50,000. In my report upon this improvement, August 23, 1866, five places were considered requiring improvement, costing $423,983. Recently I have learned of another place in the channel, just below the canal, where over the natural bottom, for an extent of 300 feet channelwise, the water was only ten feet eight inches to eleven feet deep last summer; the bottom here is hard-pan. The cost of removing this obstruction will be $13,334, according to the best data I can now obtain; this added to the foregoing sum, will make the estimate for the river, exclusive of the canal, to bring the navigation to the standard proposed, to the sum of $437,317.

5. *St. Mary's ship canal.*—The depth of water on the mitre-sill of this important work last summer was only ten and two-thirds feet. By the process of flooding, however, vessels passed drawing eleven feet. That stage of water may be regarded as the lowest, and it affords good data for determining the precise modification necessary to adapt the canal to the depth of thirteen feet below the lowest stage, the same as contemplated for the proposed canal across St. Clair flats. I have made myself acquainted with the details of construction exhibited by the official drawings of the St. Mary's canal. I find that it admits of being excavated throughout its length, and the bottoms of the locks of being made to occupy a lower position, so as to give thirteen feet of water on the mitre-sill, without destroying any of the existing work, except some immaterial, and the grillage part of the lock foundations. These foundations may be removed and new foundations and under walls put in under the present lock walls without destroying the latter. The practical engineering for these modifications is quite simple, and safe against the destruction of the existing works.

But the full and complete estimate of the cost cannot be made until after a personal inspection of the work itself; and after that it would take two weeks to make up the estimate. The modifications could be accomplished probably in one year. But in the mean time, for the season of navigation what would become of Lake Superior trade? This is a question difficult to reconcile with the work necessary to the modifications. The period of time hence is not equal to that which has elapsed since the conception of this work, before the Lake Superior trade will become so great that the present system of its single locks will be inadequate for the business, and an additional side canal will be demanded. Then will be the time to construct the new parts with adequate depth, and soon after the new shall be completed, to modify the old canal to the same draught. In conclusion, I express the opinion that beyond these already considered, it is not necessary for all reasonable purposes of lake navigation to attempt to give more depth of water than we now expect to obtain under the existing plans and estimates for the other harbors of less importance within my superintendency.

I have the honor to be, very respectfully, your obedient servant,

T. J. CRAM,
Colonel of Engineers, Brevet Brigadier General.

Brig. and Bvt. Maj. Gen. A. A. HUMPHREYS,
Chief of Engineers.

OFFICE LAKE SURVEY, *Detroit, February* 4, 1867.

SIR: In reply to your circular of the first instant, I have no hesitation in saying that the general commerce of the lake would be greatly benefited if vessels having a draught of fourteen feet could be used. To do this, however, the first point to be attained is to secure that depth in the communications *between* the lakes, and from Lake Ontario to the ocean; that is, in the St. Mary's canal; the flats of Lake George, St. Mary's river; St. Clair flats; around the Falls of Niagara, and the Canadian canals around the falls in the St. Lawrence river. None of these works being under my charge, I know nothing of the probable expense that would be incurred. Until these improvements are made, it would be neither necessary nor expedient to secure a greater depth of water in the harbors than has heretofore been proposed.

There are many of the harbors on the lakes where, owing to the small volume of water in the streams forming them, it would be inexpedient to attempt getting a greater draught than now obtains, as it could not be maintained without constant dredging.

I beg leave respectfully to submit the following in regard to the several harbors for which I have been called on to make estimates:

Superior City.—The additional length required to carry the proposed piers to the depth of fourteen feet would not exceed two hundred feet on each pier, and the additional expense would not probably exceed $25,000. The water in the St. Louis river, which forms the harbor, is abundant to maintain the depth proposed.

Ontonagon.—The stream is not believed to be sufficient to preserve the additional depth even if the piers were carried out.

Eagle harbor.—The estimate submitted was for the depth of water in the channel of fourteen feet. This was considered necessary to enable vessels drawing twelve feet to enter when there was any sea running, the entrance being exposed and the bottom rock. To give the same facilities if vessels drawing fourteen feet were used, there should not be less than sixteen feet in the entrance. This would treble the amount of rock excavation, and involve an additional expense of not less than $292,032.

Lac La Belle.—The harbor at this place is a small interior lake in which is ample depth of water. The *improvement* is a canal connecting this with Lake Superior and piers to protect the entrance. These piers were to be carried to sixteen feet of water; it is not probable that they have been founded sufficiently deep to admit of dredging between them to the depth proposed, nor is it at all probable that the flow of water from the pond would be sufficient to maintain a depth of water in the channel of over twelve feet. It would be necessary to have additional data in regard to the amount of discharge before the expediency of attempting to get greater depth in the channel could be determined upon. The proposed improvement if made would probably cost $250,000, if it should become necessary to rebuild the piers.

Marquette.—The proposed improvement at this point consists of a breakwater to afford shelter from the force of the lake waves. The depth of water behind this proposed breakwater being greater than fourteen feet, no additional expense would be incurred.

Au Sable river, Lake Huron.—The stream is not sufficient to maintain a greater depth than that which has been proposed.

Very respectfully, your obedient servant,

W. F. RAYNOLDS,
Brevet Colonel U. S. A., Major Engineers.

Major General A. A. HUMPHREYS,
Chief of Engineers U. S. A., Washington, D. C.

BOSTON, *February* 13, 1867.

SIR: In compliance with request contained in department letter of 1st instant, to report my views as to the necessity or expediency of increasing the depth of the lake harbors under my charge, so as to admit vessels of fourteen feet draught of water. I have the honor to report as follows:

These harbors are Oswego, Great Sodus and Little Sodus, N. Y. All the information which I have obtained up to this time leads me to believe that a depth of twelve feet has been heretofore considered ample. Of course a harbor which will admit a draught of fourteen feet is better than one of less depth, and there may be circumstances (such as the construction of a ship canal around Niagara Falls) which would so develop the lake commerce as to render advisable the building of larger vessels and an increased depth of water to accommodate them. But in view of the uncertainty of further appropriation and the actual condition of things, I cannot recommend that a depth over twelve feet should be attempted in the dredging intended with the funds *now* available for these harbors, and I feel very doubtful whether any part of the additional amounts recommended in my last report (viz: $60,000 for Oswego, $50,000 for Little Sodus, and $80.000 for Great Sodus) should be used in obtaining a greater depth than twelve feet. If, however, the sum of $25,000 in addition to these amounts were granted this year for each harbor, I should recommend that the increased depth required for fourteen feet draught be now given.

Very respectfully, sir, your obedient servant,

C. E. RLUNT,

Major Engineers, Brevet Lieut. Colonel U. S. Army.

General A. A. HUMPHREYS,

Chief Engineer U. S. Army, Washington City.

MILWAUKEE, WISCONSIN,
February 6, 1867.

GENERAL: I have the honor to acknowledge the receipt of engineer department circular dated February 1, 1867, asking for a report upon the expediency of increasing the depth of the harbors on Lake Michigan so as to admit vessels of fourteen feet draught.

My opinion is that, as a general rule, the principal harbors on Lake Michigan should be deepened so as to admit vessels drawing fourteen feet of water.

Vessels, generally propellers, drawing, when loaded, thirteen feet, have entered and gone out of the harbors of Chicago and Milwaukee during the year 1866, and at Racine, during the same period, a line of propellers drawing twelve and one-half feet have entered and left.

The commerce on this lake has increased immensely during the past few years, far beyond the most sanguine expectations of twenty years ago, when twelve feet of water was the usual depth selected.

This increase has augmented the number of vessels employed, and enlarged the size until a draught of twelve feet is not uncommon.

This increase in size is due to the immense grain trade of this country, and is limited only by the depth of the harbors and channels which are used by the carriers.

As an evidence of the greatness of this carrying trade, I will state that during this year, 1866. from the port of Milwaukee alone there were shipped by lake vessels 10 939,561 bushels of wheat, (nearly eleven millions,) nearly 500,000 barrels of flour, nearly 500,000 bushels of corn, over one and one-half millions of bushels of oats, and large quantities of rye and barley.

From Milwaukee you can easily judge what Chicago sends by the lake. Add to these the shipments from Racine, Sheboygan, and Manitowoc on the west shore, and the fast growing trade, especially in lumber, from ports on the east shore, we see we have a carrying trade that requires a larger number of vessels and of a larger size.

Our harbors should conform to the necessities of the case, and if practicable, at a slight addition to their cost, be deepened to at least fourteen feet. The limit to the draught of vessels sailing to and from Milwaukee and Chicago will be governed at all times by the depth of water in the channel through the St. Clair flats. As this channel is deepened, so will the grain vessels to and from these two harbors be increased in size, and a deepening of the harbors required.

We will now consider the deepening of the harbors on Lake Michigan intrusted to my charge:

1. *Aux Becs Scies.*—Examining the map of this harbor furnished by General Cram, with his report and plan in 1864, we notice a bar with a depth of twelve feet upon it, running parallel to and distant about 800 feet from the shore. The width of this bar is about 100 feet. To improve this harbor so as to admit vessels of fourteen feet draught, we have two plans before us—one to extend the piers out and over this bar, and dredge the whole water-way to the required depth; and the other to extend the piers to fifteen feet of water, dredge between the piers, and a channel through the outer bar. Making no allowance for greater depth than fourteen feet, which should be done where the vessel actually draws fourteen feet, but estimating only for this depth of water throughout, the first plan would require an extension of about 1,000 feet running of pier work, and the removal of about 18,677 cubic yards of earth and sand. The cost would be $92,838 50. The other plan would require about 300 feet of pier work, and about the same amount of dredging. The cost would be about $34,388 50. This latter plan would be recommended by me. I must here state that these figures are based on General Cram's map, and as several years have elapsed since this survey, I would recommend a new examination to be made of this locality.

2. *Grand Haven.*—This harbor was discussed in my report dated November 30, 1866. If the south pier is extended out the 600 feet recommended, the current of the river will scour out the channel to the required depth. The probable cost would be, in addition to the present appropriation, $40,111 21.

3. *Black Lake harbor.*—To improve this harbor, as required above, would require an addition of 2,150 running feet of pier work and 23,889 cubic yards of dredging. The cost of this would be about $196,469 50 in addition to what has been asked for.

4. *St. Joseph harbor.*—When the improvement recommended in my report of November 30, 1866, is made, vessels drawing fourteen feet of water can enter. The amount asked for was $22,459 84.

5. *Chicago harbor.*—This harbor would require, in addition to the present improvements contemplated, the removal of about 5,000 cubic yards of earth and sand, costing about $2,500.

6. *Kenosha harbor.*—This harbor would require an additional 228 running feet of pier work and 15,704 cubic yards of dredging. The cost of this addition will be about $26,890.

7. *Racine harbor.*—This harbor would require, in addition to the amount asked for in my report before referred to, the sum of $7,423 50 to remove about 14,847 cubic yards of sand and earth from the new channel.

8. *Milwaukee harbor.*—This harbor has its piers in fourteen feet of water, and, taking the measurement of 1865 as a guide, there will be required to remove about 16,981 cubic yards of earth and sand from between the piers, to make a channel of fourteen feet throughout. I am confident that a bar has been forming opposite the mouth of this harbor during the past year, and that it will be safe to double this amount of dredging. I would, therefore, ask for $17,000 for this harbor.

9. *Sheboygan harbor.*—This harbor would require 560 running feet of pier work, in addition to the present proposed improvement, and 19,447 cubic

yards of dredging. The cost of this additional improvement will amount to $56,483 50.

10. *Manitowoc harbor.*—This harbor would require 128 feet of additional pier work, and 21,333 cubic yards of dredging. The cost of this would amount to $21,354 66.

RECAPITULATION.

Amounts required to improve the harbors on Lake Michigan under the charge of Major J. B. Wheeler, corps of engineers, so that vessels may enter with a draught of fourteen feet.

No.	Name.	Amount asked for.	Remarks.
1	Aux Becs Scies	$34,388 50	
2	Grand Haven	40,111 21	Already asked for.
3	Black Lake	196,469 50	
4	St. Joseph	22,459 84	Already asked for.
5	Chicago	2,500 00	
6	Kenosha	26,890 00	
7	Racine	7,423 50	
8	Milwaukee	17,000 00	
9	Sheboygan	56,483 50	
10	Manitowoc	21,354 66	
	Total	425,080 71	

I am, general, very respectfully, your obedient servant,

J. B. WHEELER,
Major of Engineers.

Major General A. A. HUMPHREYS,
Corps of Engineers, Chief of Engineers U. S. A., Washington, D. C.

APPENDIX D.

ST. PAUL, MINN., *September* 14, 1867.

GENERAL: I have the honor to submit the following report of the operations conducted by me for the year ending June 30, 1867:

I was assigned to this field of duty by order from the engineer department, dated July 31, 1866. The duties were the examination and survey of the Mississippi river and its tributaries, between the Falls of St. Anthony and the Rock River rapids, viz., the Minnesota, St. Croix, Cannon, Zumbro, and, also, of the Fox and Wisconsin, as provided for in the act making appropriations for the repair, &c., of certain public works of the United States, approved June 23, 1866. This act stipulates that the navigation shall be made for vessels drawing four feet of water, economizing the water by dams, locks, sluice-ways, and all other means calculated to insure the passage of steamers of four feet draught at all navigable seasons. The subject of constructing railroad bridges across the Mississippi river between St. Paul and St. Louis, at such places, and upon such plans of construction, as will offer the least impediment to the navigation of the river, was also confided to me. A report on these matters was required, by the act before named, in time to be laid before Congress at its next session.

These duties were immediately entered upon by me, and a preliminary report, as complete as could be made at the time, was rendered to the engineer department under date of January 21, 1867. This, with the report of the Chief of Engineers, was printed as H. Ex. Doc. No. 58, 39th Congress, 2d session.

As probably always occurs in such hastily prepared and hastily copied and printed reports, some serious errors appear in the printed copy, so as to make it a somewhat unreliable reference for the information designed to be conveyed. Thus, at the bottom of page 26, I am made to speak of "encouraging the water," when I said "concentrating the water." At the bottom of page 22, the print is "17,000 cubic yards," and "2,300 cubic yards." It was meant to read 17,000 cubic *feet* per sec., and 2,300 *feet* per sec. The diagram on page 69 was reduced one-half (½) its linear scale in the publication, but the scale is given in the text as it was on the original. Numerous other corrections might be made, but these will suffice to put any one on their guard in consulting the printed document.

I will here repeat the estimates submitted by me which were approved by the Chief of Engineers:

1.—*For improvement of the Mississippi river.*

For lock and dam at Meeker's island	$235,665 00
For building and operating two dredges and snag-boats	96,000 00
For experimental dam at Prescott island	5,000 00
For experimental dam at Wacouta channel	3,000 00
For experimental beacons	800 00
Total first year	340,465 00

2.—*For improvement of the Minnesota river.*

From Yellow Medicine to its mouth, by dams and locks giving four feet water, two hundred and thirty-seven (237) miles, as follows:	
Yellow Medicine to Fort Ridgely, 60 miles	$250,000 00
Fort Ridgely to Mankato, 73½ miles	235,000 00
Mankato to Upper Le Sueur, 31½ miles	160,000 00
Upper Le Sueur to foot of Little rapids, 39½ miles	126,000 00
Little rapids to Mendota, 31½ miles	4,500 00
Total	775,500 00

A desirable improvement by the following, securing two or three feet water, was estimated as follows:

For removing snags and boulders throughout	$37,000 00
For dam and lock at Little Falls	60,000 00
For expense annually of scraper and dredge boat	20,000 00
Total for Minnesota river, giving 2 to 3 feet draught	117,000 00

For improving the Wisconsin river.

For constructing dredge and snag-boat	$25,000 00
For operating same for one year	15,000 00
Total	40,000 00

For additional surveys.

For Mississippi, above Falls of St. Anthony	$7,500 00
For Mississippi, between Falls of St. Anthony and Rock Island rapids	35,000 00
For the Wisconsin river	7,500 00
Total	50,000 00

By the act approved March 2, 1867, appropriations were made as follows:

1.—*For the Mississippi river.*

For building and operating two dredge and snag-boats	$96,000 00

2.—*For the Wisconsin river.*

For building and operating one dredge and snag-boat	$40,000 00

3.—*For the Minnesota river.*

For removing snags and boulders throughout	$37,000 00

No special appropriation was made for the surveys estimated for, but a general appropriation in its stead of $125,000 for examination and survey of western and northwestern rivers, and section five (5) of this act directed the surveys above estimated for and numerous others to be made out of this amount. The letter to me from the Chief of Engineers, of May 16, 1867, set apart the liberal allowance of $40,000 of this appropriation for surveys and examinations under my charge.

The full amount of my estimate, $50,000, could not then be promised, in view of other surveys of great importance required to be done by this appropriation. The amount allotted to me, $40,000, has proved as much as I could advantageously make use of this season, which has been one exceedingly unfavorable for surveys on the upper Mississippi, on account of high water.

I will now resume the report of operations since the date of the published preliminary report, dated January 21, 1867.

Owing to want of means, the parties engaged in office work were reduced soon after, as fast as the maps were placed in condition to easily be completed by others hereafter. Two assistants had, however, to be kept continuously on the Minnesota survey, and five on the Mississippi surveys. By orders from the engineer department of March 22, subsequently modified by one of March 26, I was made a member of the board on the improvement of the Des Moines rapids, to meet at Keokuk, April 15, 1867. I was engaged personally on this duty until May 15. After this, by authority, I visited St. Louis and Cincinnati, to examine steamboats, with a view to procuring a suitable one for dredging and snagging on the upper Mississippi and Wisconsin rivers.

I returned to St. Paul on the 9th of June. At this time the Mississippi river was, at this place, thirteen and a half feet above low water, and rising rapidly. It continued to rise till June 14, being then fifteen and a quarter feet above low water. By June 23 it had fallen to twelve feet above low water. It then began to rise again, and on June 30 was sixteen feet above low water. On the 9th of June the Wisconsin river, at Portage, was five feet above low water. It continued to fall throughout the rest of this month, being at its close two and a half feet above low water. So far, all the streams were too high to carry on advantageously any surveys other than gauging them, and this was begun at once.

The preparation of drawings and specifications for different kinds of boats required was also urged forward. On the 22d of June an advertisement was made for proposals—first, for selling to the United States steamboats to be used in scraping the sand-bars; second, for wrecking the steamer Northern Light; and, third, for removing snags and boulders from the Minnesota river—as it had become obvious that we should not be able to do anything this season with boats of our own construction, and it was hoped private parties might be able to perform the work advantageously to the public with means already provided. A favorable contract for removing snags and boulders from the Minnesota was ultimately made with Sanford A. Hooper, of Belle Plains.

The results of further operations do not come within the fiscal year ending June 30, and as my time now, in this most active period, does not allow for a full report thereon, and as the results themselves will not be fully determined till the close of the season, I deem it best to defer any further report of operations till then.

All the works in my charge are being urged forward with all the speed consistent with accuracy and due regard for economy.

The surveys on the Mississippi and Wisconsin are progressing, and on the latter will be completed this season.

The following table gives the expenditures made by me from appropriation for examination and survey of western and northwestern rivers, for the year ending June 30, 1867:

Applied to—	3d quarter, 1866.	4th quarter, 1866.	1st quarter, 1867.	2d quarter, 1867.	Total.
Mississippi river	$2,915 81	$14,504 29	$5,406 03	$3,901 61	$26,727 74
Minnesota river	339 25	3,654 22	1,034 55	990 40	6,018 42
Cannon river	128 59	1,019 80	144 37	....	1,292 76
Zumbro river	....	622 50	192 50	....	815 00
Fox and Wisconsin rivers	....	1,060 14	452 31	....	1,512 45
St. Croix river	....	....	....	....	....
Grand total	....	....	....	....	36,366 37

The season's work will, it is believed, enable us to complete the report on the subject of bridging the Mississippi between St. Paul and St. Louis, and the determination of a definite plan for improving the Wisconsin and parts of the Mississippi river.

Independent, however, of these plans, to be submitted in a future report, I deem it exceedingly desirable to have the following amounts appropriated for continuing the works next year:

First, for continuing the survey of the Mississippi river above Rock island	$50,000
Second, operating two (2) snag and scraper boats on Mississippi river	36,000
Third, experimental dam at Prescott	5,000
Fourth, experimental dam to deepen Wacouta chute	5,000
Fifth, dam and lock at Little falls, Minnesota river	60,000
Sixth, dam and lock at Meeker's island, Mississippi river	235,665

The first item, of $50,000 for surveys on the Mississippi, is very necessary. A thorough knowledge of the shifting sand-bars will require, for several years, a special survey to be repeated over the bad shoals, such as those at the mouth of the Chippewa river, so that the changes can be compared—the proper method devised for overcoming the difficulties navigation now experiences. Besides these repetitions, two more years of favorable stages will enable us to extend the survey throughout the whole of the shoal river, and the boats and other material now on hand will enable us to much increase the work done, with the same expenditure as heretofore

The second item, for operating snag and scraper boats, will have to be provided in advance annually, if the method succeeds in producing the desired result. But it is probable that the full amount will only be required in extreme low-water years, so that there will not be another amount required for the year succeeding a high-water season, after the plan is fairly in operation

The third and fourth items, for experimental dams at the head of Prescott island and Wacouta chute, are specially desirable, as affording a test of this method of improvement applied to the upper Mississippi. I much regret that these amounts were not appropriated as estimated for last year, so that, by the end of the season, the result would be known to guide me in adopting a final report. The fifth item, $60,000, for dam and lock at Little falls, on the Minnesota, is for an improvement demanded beyond any question; the benefit of the amount appropriated for removing the snags and boulders will be very imperfectly realized, unless the falls are also made navigable.

The sixth item is called for by the same reasons mentioned in the printed report, to which an item of such importance will render it worth while to refer.

The following table contains the names of the different rivers, the collection districts in which they are located, the nearest ports of entry, and the amount of revenue collected during the last fiscal year. I give them as required by instructions, but not as an indication of the value of the commerce benefited by the improvements proposed:

Work.	Collection district.	Nearest port of entry.	Revenue collected.
Minnesota river	Minnesota	Saint Paul	$30,137 32
Cannon river	Minnesota	Saint Paul	
Zumbro river	Minnesota	Saint Paul	
Mississippi river	Minnesota	Saint Paul	
Mississippi river	Galena	Galena, Illinois	9,950 71
Mississippi river	Dubuque	Dubuque, Iowa	5,141 62
Wisconsin river	Galena	Galena, Illinois	9,950 71
Fox river	Milwaukee	Depere, Southport, Racine and Sheboygan	83,815 19

Respectfully submitted:

G. K. WARREN,
Major Engineers, Brevet Major General U. S. A.

Brevet Major General A. A. HUMPHREYS,
Chief of Engineers, U. S. A.

TREASURY DEPARTMENT, *September* 25, 1867.

SIR: Your letter of the 16th instant, requesting "information as to the amount of revenue collected at the following ports of entry, for the fiscal year ending June 30, 1867, viz., Dubuque, Iowa; Galena, Illinois, and Green Bay, Wisconsin," has been received.

In answer thereto, I would call your attention to an extract of a report made by the Commissioner of Customs, to whom your letter was referred, and who reports "that the amount of revenues collected at Dubuque during the time specified was $5,141 62, and at Galena $9,950 71. Green Bay, Wisconsin, is a port of entry of the collection district of Milwaukee, and no separate return of revenue collected there exists in this office. The amount collected in the district of Milwaukee, which includes Green Bay, Southport, Racine, Sheboygan, and Depere, ports of entry, was $83,815 19."

I am, very respectfully,

J. F. HARTLEY,
Assistant Secretary.

G. K. WARREN,
Major of Eng's and Bvt. Major Gen. U. S. A., St. Paul, Minn.

APPENDIX E.

UNITED STATES ENGINEER'S OFFICE,
Davenport, Iowa, September 10, 1867.

GENERAL: I have the honor to make the following report in reference to the works under my charge, as required by engineer circular No. 11, dated Washington, June 10, 1867.

IMPROVEMENT OF THE DES MOINES RAPIDS OF THE MISSISSIPPI RIVER.

Result of resurvey, with plan adopted and items of expenditure under that plan.—Having been assigned to the duty of superintending the improvement of the Des Moines rapids, by Special Orders No. 379, dated Adjutant General's office, August 3, 1866, I proceeded without delay to Keokuk, Iowa, and after a careful examination of the rapids, together with the reports and surveys which had been previously made with a view to the improvement of navigation, I determined to make a careful resurvey of the rapids, together with a section of the river above and below the same, and to consider not only the old plan of improvement, but every other one which might seem worthy of attention. The results of this resurvey, together with the details of the plan based thereupon, were communicated to the bureau in my report of January 1, 1867.

It will be remembered that the original plan of improvement contemplated widening, deepening, and in some degree straightening the original channel, by excavating the rock from the bed of the river at such points as required it. This plan was, after careful investigation, rejected as involving too much expense, requiring too long a time to complete, and failing when finished to give an adequate improvement. In lieu thereof I recommended the construction of a lateral navigation canal, extending along the Iowa shore from Keokuk to the village of Nashville, a distance of seven and six-tenths miles, and that the improvement should be completed to Montrose by making a thorough cut, two hundred feet wide and five (or six) feet deep, along the natural channel at the upper chain. This plan I became convinced would give the best, cheapest, and simplest improvement, all things being considered, that could be devised, and could be much more readily carried into execution than any other. In view of the great importance of the work, and the necessity of its being as permanent as possible, I recommended that the canal should be made three hundred feet wide in both excavation and embankment, and five (or six) feet deep at extreme low water; that there should be two lift-locks and one guard-lock, each three hundred and fifty feet long between the gates and eighty feet wide at the top; that the embankment should be made twenty feet wide on top, be carried up to four feet above the highest known flood, and be covered outside, inside, and on the top with well-constructed rip-rap of broken stone.

My report was duly transmitted to the House of Representatives by the Chief Engineer of the army, accompanied by a letter dated February 5, 1867, and, after having been considered in the Committee on Commerce, provision was made in the general appropriation bill for carrying the plan into execution. Objections were offered to the plan in the Senate, which resulted after debate in the rejection of the item making the appropriation called for, and substituting therefor the sum of $500,000 "for improving navigation at Des Moines or lower rapids, according to such plan as the Secretary of War shall, on the report of a board of engineers, approve." Accordingly, on the 22d of March, 1867, the Chief of Engineers issued an order by the authority of the Secretary of War, convening a board of engineers to meet at Keokuk, Iowa, to consist of Brevet Brigadier General T. J. Cram, corps of engineers; Brevet Colonel John N. Macomb, lieutenant colonel of engineers; Brevet Major General J. H. Wilson, lieutenant colonel thirty-fifth infantry; Brevet Major General G. K. Warren, major of engineers; Mr. W. Milnor Roberts, superintending engineer Ohio river improvements, with Brevet Lieutenant Colonel P. C. Hains, captain of engineers, as recorder. The subject of the improvement of the Des Moines rapids was committed to the board "without restrictions." The board met at Keokuk, Iowa, on the 16th of April, adjourned to Davenport, Iowa, on the 30th of April, and continued in session till the 13th of May. All the maps and plans which I had prepared, together with the reports of the previous surveys, were laid before the board, and, after a careful and exhaustive consideration of the entire subject in all its aspects, they recommended the plan which I had adopted, making no changes except in details, and fixing one point which I had left open for the decision of the bureau. The general arrangement and location of the canal are left as suggested in my report of January 1, but the embankment is reduced to ten feet in width on the top, with a rip-rap covering two feet thick, and is to be carried only two feet above extreme high water, instead of four feet. The prism of the canal is left at 300 feet wide in embankment, but reduced to 250 feet in excavation; the minimum depth of water is fixed at five feet, maximum depth eight feet.

It will be observed that while these changes are all of a character to decrease the cost of the improvement, they diminish its strength and capacity in a like degree. In these matters I have deferred to the greater experience and observation of a majority of the board, without entirely yielding my convictions on all the points involved.

The conclusions and recommendations of the board having been concurred in by the engineer department, were submitted to the Secretary of War, and having received his approval, I was instructed, July 19, 1867, "to proceed at once to carry out the plan of improvement reported by the board."

In pursuance of these instructions, I advertised for proposals for excavating the prism and building the embankment of the canal, to be opened September 4. This part of the improvement was selected, after conferring with the board of engineers, as the first to be commenced, for the reason that the embankment, being throughout most of its length in the river, will require a more uncertain length of time for its completion, and will involve greater risk of being delayed, than the locks. After partial completion it will afford the means of protecting the locks from interruption or damage by high water or ice. In addition to this being all "section work," it will require no contract for "materials," and only one for labor; whereas, if the present oppressive laws governing contracts should be strictly adhered to, the locks would require contracts for masonry, carpentry, and smith-work, as well as for several different classes of materials. Finally, it will be seen hereafter that the $700,000 already appropriated will complete nearly the entire embankment, leaving only the locks and the channel improvement at the "upper chain" to be provided for by future appropriations.

The resurvey of the Des Moines rapids was paid for out of the appropriation "for the examination and survey of western and northwestern rivers," and cost $8,059 67.

In carrying into execution the plan of improvement adopted, $3,993 50 had been expended on the 1st of September for the purpose of paying contingencies of engineering and civil engineer assistants engaged in laying out and preparing the work for the contractors. This is charged to the appropriation "for the improvement of the Des Moines or lower rapids of the Mississippi river."

The excavation and embankment, together with the items connected therewith, in the report of the board of engineers dated July 20, 1867, are estimated to cost $1,150,353; but it will be seen from the abstract of proposals herewith that this work will be contracted for at a saving on the estimates of $438,694. Without making a corresponding reduction in the cost of the locks and channel improvements, it is estimated that $1,479,647 will be required for the entire and permanent completion of the work in accordance with the plans adopted, namely: for contingencies in the completion of the embankment and excavation, $100,000; for the locks, gates, and channel improvement, $1,379,647, of which $1,200,000 can be profitably expended on the work during the fiscal year ending June 30, 1869, exclusive of the sum already appropriated. But the entire improvement can be economically finished by the 1st of November, 1869, and hence I feel it my duty to respectfully recommend that the total sum requisite, namely, $1,479,647, shall be appropriated at the next session of Congress. This will result in an actual saving of money to the government, and will not necessitate drawing money any more rapidly from the treasury than if it were provided for by two or more appropriations.

This work is situated in the first collection district of Iowa, 250 miles from Chicago, the nearest port of entry, and 208 miles from St. Louis, the nearest port of delivery.

During the fiscal year ending June 30, 1867, $547,558 80 were collected at Chicago on customs; $18,935 38 were received as emolument fees; 640 vessels, with a registered capacity of 93,964 tons, are reported as owned in the district; 11,374 arrived at that port, and 11,497 cleared from it, during the year.

At St. Louis the receipts on customs during the fiscal year ending June 30, 1867, were as follows:

Duties on imports	$967,597 33
Tonnage duties	31,529 61
Tonnage tax, &c	14,167 78
Hospital duties	8,721 46
Total	1,022,016 18

Two hundred and one steamboats are reported as belonging to the port, with a registered capacity of 89,515 tons, and 81 barges, flats, &c., of 15,790 tons.

The secretary of the Chicago Board of Trade, in his ninth annual report, showing the trade and commerce of that city for the year ending March 31, 1867, states the shipment of flour (reduced to wheat) and grain to have been 66,736,660 bushels, an increase over the year 1865-'66 of 13,524,436 bushels, and 10,252,550 bushels over and above the shipments of any other year in the history of Chicago; also that 672,769 head of hogs and 25,998 head of cattle were packed at that place. The receipts of lumber were 730,057,168 feet of lath, 123,992,400 pieces, and 400,125,250 shingles, showing an increase over the preceding year of 82,901,434 feet of lumber, 57,897,300 pieces of lath, and 89,227,900 shingles.

For a detailed statement of the amount of commerce and navigation which would be benefited by this improvement, I respectfully refer to my report of January 1, since which time I have gathered no new statistics.

An abstract of the proposals for the "section work" (opened on the 4th instant) is forwarded herewith, from which it will be seen that Messrs. William

Hennegan & Son, of Mt. Vernon, Ohio, are the lowest bidders, and William Armstrong & Co., of Philadelphia and Keokuk, are the next in order. The contract not having been entered into yet, no "abstract of contracts" can be forwarded at this time. Specifications of the section work are submitted herewith.

ROCK ISLAND RAPIDS OF THE MISSISSIPPI RIVER.

In my report of January 1, 1867, I made a detailed statement of the results of the resurvey of these rapids, and the plan adopted for their improvement. It will be remembered that in an extent of fourteen miles they afford eleven miles of good navigation, and that only three miles are dangerous or difficult to pass during the low water stages. The river bed itself, being much narrower than at the lower rapids, and the fall of twenty-two feet being distributed nearly equally over a distance of fourteen miles, it was determined to adhere to the original plan of excavating and straightening the natural channel. This plan, involving the removal of about 57,500 cubic yards, received the approval of the engineer department, and Congress made an appropriation of $200,000, which, with the $100,000 previously appropriated, but unexpended, gave the sum of $300,000 for the prosecution of the improvement. Accordingly, on the 10th of April I was directed by engineer letter to invite proposals for doing the work. This was done immediately, and on the 5th of June following a letting was made at which Charles G. Case & Co., of Fulton, New York, were found to be the lowest responsible bidders. In pursuance of instructions from the engineer department, dated June 12, 1867, a contract was made with them on the 28th of June, by which they are bound to begin the work one month after the date of contract, or as soon thereafter as the water shall reach a stage four feet above the low water of 1864, to work at such points as the engineer in charge shall direct, and to remove at least 5,000 cubic yards of rock per month. The contractors are authorized to use coffer dams, chisels, or sub-aqueous blasting, as they may think best, but all tools, implements, and materials of whatever character must be furnished at their own expense, the government paying only for work done in accordance with the specifications of the contract.

The contractors are men of experience and energy, and may be depended upon to accomplish what they have undertaken. So far, however, owing to the unusual continuance of high water throughout the summer, they have not been able to fairly begin work. They have provided themselves with two of Osgood's patent rock chisels, weighing nearly eight thousand pounds each, (operated by machinery similar to that used for pile-drivers,) one dredge, all the lumber and iron required for coffer dams, and the necessary steamboats and barges for towing and handling their materials. Up to the present time, on account of high water, they have not been able to do more than to put their chisels, dredges, and barges into position, and to test the various parts of the machinery appertaining thereto. The chisels are just fairly getting to work on one of the upper reefs of Duck Creek chain, and to-day the contractors are beginning to construct a large coffer dam immediately below the point at which the chisels are working, for the purpose of cutting through the principal chain at Duck creek and taking out the points marked on our charts.

No estimate will be made of work done till the end of the current month, and hence I have no items of expenditure under this plan to report, except such as are involved in contingencies and engineering while preparing the work for the contractors. Under these heads $5,853 73 have been expended, duly accounted for, and charged to the appropriation for the "improvement of the Rock Island rapids of the Mississippi river."

It is estimated that $813,601 80, including the $300,000 already appropriated, will be required under the plan adopted for the entire and permanent completion of this improvement, and that $513,601 80 can be profitably expended during the fiscal year ending June 30, 1869. This sum should be appropriated and made available as soon as possible, in order that advantage may be taken of every favorable opportunity presented by low water in the river for doing the work. If the necessary funds are provided, there is no good reason that can now be foreseen why the improvement of both the upper and lower rapids may not be completed by the 1st of November, 1869.

The upper, or Rock Island, rapids are situated in the second Iowa collection district; the nearest port of entry is Chicago, at which the collections upon customs amounted to $547,558 80 during the last fiscal year.

Abstracts of proposals and contracts, with the names of the contractors, for this work are herewith submitted, together with the report of my assistant, Brevet Lieutenant Colonel P. C. Hains, captain of engineers, to which, and the accompanying diagram showing the stages of the water at this place during the last seven years, the attention of the department is invited.

LAWS GOVERNING CONTRACTS.

Before leaving this part of my report, I desire to call the attention of the department to the laws governing contracts, so far as the same concern and are applied to the construction of public works. Section 3 of the act of Congress approved March 2, 1867, "making appropriations for the repair, preservation, and completion of certain public works," requires that "whenever the Secretary of War shall invite proposals for any works, or for any materials or labor for any works, there shall be separate proposals and separate contracts for each work, *and also for each class of materials or labor for each work.*" Section 3 of an act approved June 23, 1860, "making appropriations for the legislative, executive, and judicial expenses of the government," &c, provides that no contract, except for army supplies, shall be made by the War Department, "except under a law authorizing the same, *or under an appropriation adequate to its fulfilment.*"

In the works under my charge, it would be possible, by a close adherence to the law first cited, to make a technical division of the labor and materials required into several more classes than is customary among civil engineers engaged in the construction of similar works. For instance, the work of excavating the prism and building the embankment of the canal for the improvement of the Des Moines rapids, instead of being considered as one class, under the general head of "section work," is capable, as will be seen by referring to the specifications, of being divided into a number of items, such as "earth excavation," "rock excavation," "embankment," "lining," "puddling," "riprap," &c., &c. As a matter of course it is, therefore, quite possible to invite separate proposals, and to make separate contracts, not only for these different items, but for the different kinds of materials required in the same; but it would be hardly possible for any engineer or set of contractors under such a construction of the law to complete the work in question at anything like a proper cost, or within a reasonable length of time. Take, for instance, the items of "earth excavation" and "rock excavation," and suppose separate contracts made for them. It will be seen at once, that as the river bank at the points where it is crossed by the canal is composed of mingled detritus, sand, gravel, broken rock, and rock in strata, it would be almost impossible, and certainly unprofessional and extravagant, to attempt to remove these different materials by different contractors. But the difficulty and confusion would not end here, for these materials are necessary in the river wall of the canal, and must be used as "lining," "puddling," "embankment," or "rip-rap," according to quality. Preparing, hauling, and placing them in the work would necessarily involve new items of labor, and require new contracts and contractors, and this would result in interminable trouble and confusion. It is not necessary to follow this subject further, although by so doing it might easily be shown that in the case of the work involved in the construction of locks, a rigid adherence to the provisions of the law would lead to similar confusion, and would result in an equally wasteful expenditure of the public money. I have not been able to devise any other way of carrying on the works under my charge than by giving a liberal construction to the law and dividing the labor into general classes, as indicated above, and also in my correspondence with the bureau. But even with this I have no hesitation in saying that the law, so far as it applies to works which ought to be done by contract, should be repealed, or at least so much of it as requires contracts for different kinds of labor and materials to be made with separate parties after separate advertisements for proposals. I am convinced that the law, in its present shape, rigidly construed, will materially delay the works under my charge, and make them cost the government twenty-five per cent. more than they would with the law repealed.

I have also to call the attention of the bureau to the law limiting contracts to the amount already appropriated; in other words, requiring new contracts to be made for each new appropriation. It seems to me, after careful observation, that this law should also be repealed, or so amended as to leave it discretionary with the War Department to make new contracts or not, as might seem most advantageous to the public interests. Many contractors, in bidding for labor or materials on works to be completed by successive appropriations, would be willing to take the risk of Congress providing the necessary money, and would therefore propose cheaper rates for the entire work than they could otherwise possibly afford. This was particularly the case with nearly all of the contractors who proposed for the work of improving the Rock Island rapids, and I have no doubt the successful bidders would gladly have reduced their bid twenty-five per cent. could they have had any assurance that they would be permitted to do the entire work without making a new contract. How they could afford to make such a reduction will become plain enough when it is remembered that they will be compelled to make almost as large an outlay for boats, machinery, and lumber to do $300,000 worth of work as would be necessary to do $800,000 worth.

I have also been somewhat embarrassed in carrying out the instructions of the department in regard to beginning the Des Moines rapids improvement, by the absence of any general law, so far as I can ascertain, regulating the condemnation of private property for public use, or even providing for the assessment and payment of damages to private parties, in cases like the above, where it is necessary for the improvement to cross private lands, and to take materials from those adjacent. Section 7 of the act approved May 1, 1820, for the "establishment and regulation of the Treasury, War and Navy Departments," specially provides: "That no land shall be purchased on account of the United States, except under a law authorizing such purchase." It may be that the statutes of Iowa regulating such matters are so framed as to permit the general government to take such action in the case under consideration as any chartered company would be required to take in a similar case. I am investigating this point now, but it has occurred to me that in any event the passage of a general law by Congress for the regulation of such matters when the government is an interested party, would materially facilitate the location and construction of such public works as are intended to improve navigation or to extend the means of intercommunication between the different parts of the country.

SURVEY OF THE ILLINOIS RIVER.

A detailed report, setting forth the results of the resurvey of this river during the fall of 1866, was made on the 15th of February, 1867, but, as our operations were confined to that part of the river lying below La Salle, it was thought necessary to extend the survey to Lake Michigan, before absolutely fixing upon the plans of improvement, and estimating, finally, the cost of carrying them into effect. I therefore recommend a detailed and exhaustive survey of the country lying between La Salle and Chicago, and of a low-water survey of the river from La Salle to its mouth. Congress acted upon this recommendation, and made the necessary provision for defraying the expense that would thereby be incurred. Accordingly, I was informed by engineer order, dated May 8, 1867, that $20,000 of the appropriation "for surveys of western and northwestern rivers" would be set apart for this purpose. I had estimated that this sum would be sufficient, but, having been directed to pay the salary of William Gooding, United States civil engineer, out of it, the sum actually available for the payment of the parties in the field will not exceed $17,000. The survey extending over 400 miles, and requiring about five months for its completion, and three months for the preparation of plans and reports, the funds thus decreased will prove inadequate, by about $5,000.

On the 13th of May I received the order just mentioned, from the engineer department, organizing a board of engineers, to consist of myself and Mr. William Gooding, United States civil engineers, for the purpose of "conducting surveys and examinations, and preparing plans and estimates for a system of navigation by the way of the Illinois river, between the Mississippi and Lake Michigan, adapted to military, naval and commercial purposes, in accordance with the act of March 2, 1867." In pursuance of these instructions, after conferring fully with Mr. Gooding, I assigned my assistant, Colonel James Worrall, civil engineer, to the immediate charge of the surveys, directing him to organize his parties, and begin the work at Chicago, at as early a date as the season would allow.

On the 19th of June, the weather having been unfavorable up to that time, he began the survey of the main line with one party, under the immediate control of Civil Engineer Assistant George B. Griffin, at Bridgeport, on the south branch of Chicago harbor, taking careful and accurate notes of the present canal, the summit, the Des Plaines valley, and all alternate lines. This party has completed its work thoroughly as far as Ottawa, on the Illinois river, and by the 15th instant will reach La Salle.

Early in July a second party was organized under the control of Civil Engineer Assistant George A. Keefer, with instructions to survey and examine the Calumet and the Kankakee, together with the country lying between the latter and the lake, for the primary purpose of ascertaining whether or not a feasible line for the improvement could be found in that direction.

This party has already completed the survey of a line from a point near Lemont, called "the sag," (Saganaska creek,) following the Calumet feeder of the Illinois and Michigan canal to Blue island, and thence across the divide to Momence, on the Kankakee. From Momence a reconnoissance of the Kankakee, extending some thirty miles into Indiana, was made, during which soundings and topographical notes were taken, but the swampy nature of the valley above Momence prevented the use of instruments for a detailed survey.* Mr. Keefer's party has just finished the survey of the Kankakee from Momence to its junction with the Des Plaines, and will probably spend the balance of the month on the lower part of the Fox. As soon as that part of the work is disposed of he will be sent to the lower Illinois with instructions to make a careful examination and survey of the localities likely to be selected for dams and locks, and to assist in completing the hydrographical and topographical survey of the river.

Late in August the Illinois river having reached the lowest stage known for several years, a third party was organized under the control of Civil Engineer

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* During the reconnoissance Colonel Worrall received a severe injury in his right hip and thigh, by falling from the gang plank of the little steamer used by the exploring party, and since then has been confined to his bed.

Assistant L. L. Nichols, aided by Civil Engineer Assistant R. E. McMath, for the purpose of surveying the bed of the river, and particularly the sand-bars below La Salle.

Before getting this work fairly begun Mr. Nichols was summoned to New York to give testimony before a committee of the legislature, and Brevet Lieutenant Colonel H. A. Ulffers, civil assistant, was sent from this office to carry forward the important investigations connected with this part of the survey. His party has already reached Negro creek, and is making satisfactory progress.

Careful and detailed instructions have from time to time been issued from this office, with the concurrence of Mr. Gooding, covering every point of interest and importance connected with the survey, and it is believed that we shall be able to report fully by the 1st of January in regard to its results, and also to submit detailed maps, plans and estimates of the improvement based thereupon. During the months of July Mr. Gooding and myself, accompanied by one assistant, made a careful examination of the country between Lake Michigan and La Salle, including the valleys of the Des Plaines, Kankakee and Illinois rivers, and also a part of the Fox, which, taken in connection with the instrumental survey, will enable us to decide definitely upon all the details of the plan, location and character of the proposed "system of navigation." As soon as the survey of the lower river has advanced sufficiently we shall make a like examination of the valley from La Salle to Grafton. So far as we can judge now, the results of this year's operations will confirm the facts developed by the survey of last fall and approve the general plan of improvement based thereupon, as recommended in my report of February 15, 1867.

The survey of 1866 cost $5,857 36, and up to the date of this report the field operations of this season have cost $9,730 39, and it is estimated that about $15,000 will be required for its entire completion. Of this sum there is an unexpended balance of $10,269 61 yet available, and it is hoped that $5,000 more from the appropriation "for surveys and examinations of western and northwestern rivers" may be allotted to this work, and thus remove the necessity for any further appropriation.

The region traversed by this survey lies in several collection districts of Illinois, whose designations are not known to this office; the nearest port of entry is Chicago, at which $547,558 80 were collected on customs during the last fiscal year.

RECOMMENDATIONS.

Before leaving this part of my report it may not be improper to call the attention of the department again to the fact that the legislature of Illinois during its last session passed an act looking to the improvement of the Illinois river and the enlargement of the Illinois and Michigan canal, provided proper assistance can be obtained from the general government. While this is a work of such vast importance to the people of Illinois as to fully justify them in undertaking it, even without assistance from other sources, I am fully persuaded that the commercial, military and naval interests of the entire country call for its commencement and completion under the auspices and by the assistance of the United States.

For this reason I take the liberty of recommending the passage of an act providing for the commencement of the work as early in the spring of 1868 as the season will permit, and in accordance with the plans to be submitted hereafter, when the survey now in progress shall have been finished and the results and estimates made known. It is safe to say in this connection that these estimates will fall within the limits of those submitted in my report of February 15, and that enough is known of the probable cost and the whole improvement to warrant the action that I suggest, particularly since all the details which may be required will be prepared for the consideration of Congress before action can be taken.

SURVEY OF THE ROCK RIVER IN WISCONSIN AND ILLINOIS.

This survey was provided for by act of Congress approved June 23, 1866, and was made under my supervision by Civil Engineer Assistant James Worrall, assisted by Civil Engineer Assistant William F. Shunk, during the fall of 1866. It was begun at Fond du Lac, Wisconsin, on the 1st of September, and finished at Rock Island, Illinois, on the 1st of December. Carefully prepared maps, profiles, and plans for a system of canal and slack-water navigation of the greatest dimensions that Lake Horicon, the summit level, could be made to supply, have already been submitted. Of this navigation, $167\frac{42}{100}$ miles can be provided for by building twenty-two dams and locks along the Rock river; the remainder, $117\frac{58}{100}$ miles, will have to be obtained by the construction of independent canal and locks.

From the south end of Lake Winnebago to Green Bay good navigation is already provided, and is susceptible of enlargement to any desired capacity by the enlargement of the Fox river improvement.

The locks recommended for the Rock river improvement were fixed at a length of 200 feet between the mitre-sills, and a width of thirty feet. The width of the independent canal was fixed at eighty-eight feet on the water surface in deep cutting, and ninety-eight feet in shallow cutting. The depth of water throughout the entire system was calculated at seven feet. The entire cost of this work is estimated at $14,738,370.

Plans were submitted for a smaller canal and slack water, giving a depth of five feet only, and estimated to cost $5,252,013.

This system of navigation is now called for by the local interests of Wisconsin, Illinois, and a part of Iowa. Its national importance is inferior to that of the Illinois river only by the difference of capacity of development. Should Congress think it advisable to extend the national aid to this line of communication between the lakes and the Mississippi, it should insist upon the adoption of the most commodious plan of improvement, for reasons fully set forth in my detailed report on this subject.

The surveys, maps, and plans were made at a cost of $8,874 99, and were paid for out of the appropriation "for the surveys of western and northwestern rivers." Having been completed, no further appropriations are required. The line of the survey traverses several collection districts in Illinois and Wisconsin, the designation of which are not known at this office.

In addition to the documents previously mentioned in this report, I transmit herewith a list of the civil engineers at present engaged on the works under my charge.

For all other details, not sufficiently set forth herein, the department is referred to my correspondence, returns, statements, and reports now on file in the bureau.

I am, general, very respectfully, your obedient servant,

J H. WILSON,
Lieut. Col. Thirty-fifth Inf., Bvt. Maj. Gen. U. S. A.

Brigadier General A. A. HUMPHREYS,
Chief of Engineers, U. S. A., Washington, D. C.

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UNITED STATES ENGINEER OFFICE,
DES MOINES AND ROCK ISLAND RAPIDS IMPROVEMENT,
AND ILLINOIS AND ROCK RIVER SURVEYS,
Davenport, Iowa, January 1, 1867.

GENERAL: I have the honor to submit the following report and recommendations in regard to "the improvement of the Des Moines and Rock Island rapids of the Mississippi river."

Having been assigned by the War Department to the superintendence of these works, August 3, 1866, I proceeded to Washington city as soon as possible after the completion of the duties upon which I was then engaged in connection with the defences at Delaware bay and river. While at Washington, making arrangements to secure copies of such maps and reports concerning the improvement to which I had been assigned as might be on file in the engineer bureau, I received the following instructions:

ENGINEER DEPARTMENT,
Washington, August 14, 1866.

GENERAL: In obedience to Special Orders No. 379, Adjutant General's Office, August 3, 1866, you will proceed to Keokuk, Iowa, to superintend the improvement of the Des Moines and Rock Island rapids of the Mississippi, and the survey of the Rock river in the States of Illinois and Wisconsin, with its connection with Lake Winnebago.

In addition to the above duties you are hereby assigned to the survey of the Illinois river from its mouth to La Salle.

You will accordingly make the necessary arrangements for the prosecution of the above duties, which it is very desirable should be commenced at the earliest practicable period, that the bureau may place before Congress at its next session the result of your examinations and plans of improvement.

You are authorized to employ as many civil assistants as you may require, at such compensation as will command suitable qualifications, to be subject to the approval of the department, with the mileage allowed to officers while travelling on duty.

Very respectfully, your obedient servant,

A. A. HUMPHREYS,
Chief of Engineers, Brig. and Bvt. Maj. Gen. U. S. Army.

Brevet Major General J. H. WILSON, U. S. A.,
Corps of Engineers, Washington, D. C.

ENGINEER DEPARTMENT,
Washington, August 15, 1866.

GENERAL: The amounts appropriated for the improvement of the Des Moines and Rock Island rapids, in the Mississippi river, by act of Congress approved June 23, 1866, for repairs, &c., of certain public works, are in accordance with the report of the Bureau of Engineers of the 1st of March, 1866, (a copy of which has been sent to you, founded upon the estimates of the board of engineers of August 26, 1854.)

The efforts of the department have been heretofore directed to the removal of the obstructions in the rapids, with a view of securing a continued low-water channel of two hundred feet width, and four feet depth, throughout. Your attention is now directed particularly to this subject, and, in resuming operations at these localities, a careful examination or survey of those portions that have been improved should be made to ascertain if any modification of the plan shall be deemed necessary and proper.

The main object is to promote the interest of commerce by additional facilities to overcome the existing difficulties upon the rapids, under the conditions of the above act, until a plan shall have been adopted to secure a safe and convenient navigation to the naval and commercial vessels of the United States. The latter subject is, also, placed with you for investigation, and an early report is desired from you, with a plan accompanied by the necessary drawings, and estimates of cost matured after complete examination and surveys of the localities.

The surveys of Rock and Illinois rivers will also require your attention, and your report and plan of improvements, accompanied by estimates, should be submitted as soon as it is possible to obtain the necessary data therefor.

Your operations will be strictly conformable with the provisions of the act referred to, respecting contracts and the information to be incorporated in your report.

Copies of such reports and drawings of the works as you may need, and now on the records of the bureau, will be furnished.

Very respectfully, your obedient servant,

A. A. HUMPHREYS,
Chief of Engineers, Brig. and Bv't. Maj. Gen. U. S. Army.

Brevet Major General J. H. WILSON, U. S. A.,
Washington, D. C.

In addition to the foregoing instructions, I conferred freely with the Chief Engineer, and his assistant, Brevet Colonel I. C. Woodruff, in regard to the scope of the duties to which I was assigned, and, in accordance with their views, made my arrangements for a thorough examination of both rapids, and for the exhaustive consideration of all the plans of improvement which had been suggested, or might present themselves during the survey.

Brevet Lieutenant Colonel P. C. Hains, captain of engineers, was directed to repot to me, to assist in the investigations, and the sum of $28,500, out of the general appropriation for "the survey and examination of western and northwestern rivers," was placed to my credit for the purpose of defraying the expense of the various surveys under my charge.

It was estimated that $10,000 would be required for the survey of the rapids.

Having proceeded to Keokuk, Iowa, and organized the field parties for the survey of the Rock and Illinois rivers, I directed Colonel Hains to take post at Davenport and assume personal charge of the Rock Island rapids survey.

He was instructed "to examine and survey accurately the places on the rapids where boats experience difficulty and encounter danger from shoal water, swift currents, and tortuous channels, so that an accurate estimate may be made of the amount of excavation necessary to render navigation safe and expeditious; to locate correctly the Rock Island railroad bridge on his maps, ascertain the direction of the currents through its bays, state its general influence upon the free navigation of the stream by all kinds of craft, to obtain all the data within reach in regard to the cost of rock excavation under water, by the various practicable means, to note the condition and influence of the dams at Moline, and ascertain whether or not they might be continued for mill purposes without injury to the navigation of the open river."

He was also directed to carefully survey the river valley on both sides, with accurate instruments, theodolite, level, and chain, along the rapids for five or six miles above and below, so as to show on his maps both longitudinal and cross sections of shores and water; to make careful observations of the velocity of the current at various points on the rapids, as well as above and below them;

and, in short, to obtain every kind of information likely to throw light upon the various plans of improvement which might be presented for discussion. In order to complete the work assigned him at the earliest possible day, Colonel Hains was authorized to employ as many civil engineer assistants as might be necessary.

The report of Colonel Hains and that of the board of engineers convened at his request are submitted herewith as a part of my own report.

The survey for additional information at the Des Moines rapids was intrusted to H. A. Ulffers, civil engineer, brevet lieutenant colonel volunteers, assisted by Ernst F. Hoffman, civil engineer, late major and additional aide-de-camp, United States army, under similar instructions to those given to Colonel Hains. The instruments furnished by the engineer department and used in these surveys were of the best quality, and every precaution was taken to secure extreme accuracy. Upon an examination of the surveys made by Lee and Warren, it was thought necessary to make entirely new surveys, not only to verify the maps projected from the old data, but to extend the information sufficiently to allow a thorough discussion of the entire subject. Lee's map, made in 1837, was found to be of no use, except to give a general idea of the topography and hydrography of the localities; while Warren's, although sufficiently accurate, has been made to illustrate simply the projects of excavating a channel in the bed of the river.

Before proceeding to the discussion of the various plans of improvement which I have thought entitled to consideration, I desire to state that as it is required the entire fall till the beginning of the severe weather of winter to finish the field work of the surveys, it has been found impracticable to submit with this report minute and detailed maps and specifications of the plans of improvement herein recommended, but they will be prepared as soon as the necessary time can be devoted to that purpose. The general plans, with maps to illustrate them, as well as the estimates of cost, have been made with great care and sufficiently in detail to give a correct idea of the localities and the works adapted and to them, as well as what it will cost to carry them into execution speedily and economically.

THE DES MOINES RAPIDS.

The Des Moines, or lower, rapids are situated near the mouth of the Des Moines river, and extend from Keokuk to Montrose, a distance of about eleven miles. During the low water season they interpose a serious, and at times an absolutely impassable barrier to steamboat navigation.

The upper Mississippi, from St. Paul to the mouth of the Missouri, has, during the lapse of more recent geological periods, worn for itself a valley varying from one to fifteen miles in width, and sunken below the general level of the prairies on either side from one hundred and fifty to three hundred feet. In many places and for much of the distance the valley is cut through a strata of rock, varying in thickness, hardness, and mineral characteristics. Without discussing the agencies by which this erosion, so disproportionate to the present powers of the river, has been effected, the Des Moines rapids present evidence strongly confirmatory of changes in the river itself. General Humphreys, in his report upon the hydraulics of the Mississippi river, suggests that it was formerly a clear water river like Niagara, fed by a fresh water lake or lakes of great extent, occupying a large portion of what is now prairie land of Illinois and Iowa, and that its transformation "from a clear into a muddy stream may have been the result of changes which have taken place in its basin." In support of this theory he refers to the passage of the river through the northeastern extremity of the Ozark mountains at "Grand Tower," below St. Louis, where the water has cut down through beds of rock upwards of three hundred feet thick, and probably drained the lake just mentioned. Another instance, developed by the survey and examination of my assistant, Colonel Ulffers, amounting almost to a proof, can be found at the head of the Des Moines rapids. Just below Montrose the rocky bluffs recede at right angles from the river, bearing gradually to the northward, and enclosing a considerable extent of country above and to the westward, which was once evidently the bed of an extensive lake, whose outlet was at the rapids, and whose surface was about one hundred and five feet above the present low water level. This lake basin is an extensive level plain, intersected by a network of sloughs, its lower part subject to annual overflows and covered with a heavy growth of willow, maple, hickory, haw, and vines. The terraces around it are well developed and of an unvarying height. Its upper end and, in part, its western side are united by beds of loam, rising one hundred and fifty feet above low water at Fort Madison, and forming the entire river bluff at this place. How far this loam deposit extends above and into the interior of Iowa has not yet been determined, and therefore what may have been the extent of the lake itself in these directions cannot be ascertained.

As before stated, the outlet of this lake was at the present head of the lower rapids. The waters stored up there have, by their ceaseless action for ages, assisted by ice and other geological agencies, gradually eroded for themselves a channel at least a mile wide, nearly two hundred feet below the general level of the prairies, and extending through limestone rock to the mouth of the Des Moines river and beyond. This erosive action, though productive of such remarkable results, has not yet been carried sufficiently far to render the river through this part of its bed available and safe at all times for the purpose of navigation. From Fort Madison to Montrose the river is about 2,500 feet wide and sufficiently deep, but on the rapids its bed of limestone rock, which, by some unknown cause, seems to have been hardened to a greater degree than the corresponding stratum above and below the rapids, has resisted the action of the water, while its sides have given way. The result is that this mass of rock remains there acting exactly as an artificial dam, whose upper surface slopes about twenty-two feet in eleven miles, and conforms very nearly to the plane of stratification of the rocks through which the channel is cut. The bluffs extend along the banks of the river throughout the length of the rapids, presenting a rock escarpment at the present high water mark, with a sloping gravel beach to low water, and also another escarpment of rocks at one hundred and five feet above the present water level, having likewise a sloping beach at its foot. The exposed ledges are formed of different strata in different localities. At some places they are brecciated limestone, (near Montrose,) in others magnesian limestone, (above Larey's creek,) and in others the coal measure sandstone, (below Price's creek;) but notwithstanding the varying hardness of these strata, they have all been cut through equally by the river in its progress from the upper beach just mentioned down to the one at the present low water level on the rapids. About sixty feet of these bluffs, however, consist of the grade bed lying between the two beaches, and made up mostly of an accumulation of clay and marls, easily washed away. The river, in forcing its way through these beds of stubborn materials, must therefore have gradually receded from the foot of the rapids, like the Niagara is doing now, until it reached its present condition. Undoubtedly the process of smoothing its path is still going on, although in an imperceptible degree. In places where the bluffs recede from the bank at the mouth of creeks emptying into the river, there are two "terraces" besides the present river bottom, respectively twenty-five and seventy feet above present low water.

The level part of the town of Nauvoo, at the head of the rapids, opposite Montrose, is built upon the twenty-five foot terrace, which is likewise prominent around the edges of the plains between the latter place and Fort Madison. The seventy foot terrace is most prominently developed near Sandusky.

The total length of the Des Moines rapids, measured along the Iowa shore from Montrose (old Fort Des Moines) to the St. Louis Packet Company's landing at Keokuk, (station D to station V,) is 10.92 miles; on the Illinois side, from Nauvoo to the Hamilton ferry landing, (station 23 to station 84,) is 12.20 miles, or a mean of 11.56 miles.

The total fall in this distance on the Iowa side is 22.046 feet; on the Illinois side, 21.933 feet; or a mean of 21.989 feet—sensibly 22 feet. The difference of the two lines of levels, being only .113 of an inch, may be regarded as inappreciable.

The mean width of the river is about 4,500 feet on the rapids, or almost 2,000 feet wider than it is above and below; its mean depth, calculated from upwards of 2,000 low water soundings,* is 2.4 feet, though there are large areas where the depth is much less; its average area of cross sections is 17,550 square feet, at ordinary low water; its mean surface velocity is 2.88 feet per second, and its mean velocity deduced therefrom is 2.304 feet per second. From these data the discharge has been calculated, and is found to be 40,435 cubic feet per second.† For extreme low water 1.5 foot must be subtracted from the average depth, which will give 24,883 cubic feet per second.

The bed of these rapids, throughout its entire length, has reached a stratum of "cherty limestone," belonging to the Keokuk group of the carboniferous series. The nature of this rock, consisting as it does of thin beds of limestone interstratified with at least an equal amount of brittle chert or limestone, precludes the idea that the different reefs, or heads of chains, might be occasioned, as formerly supposed, by a succession of strata which in their outcrops would form a barrier across the river. The deeper parts of the rapids are all caused by erosion, originating partly from the strength of the current, aided by the presence of numerous granite boulders, and partly by masses of ice which are annually swept down by the spring freshets with tremendous force.

In the various soundings carried across the river no trace was found of pools or places where the area of the cross section would be sensibly greater than on the heads of the chains. In other words, there is no proper chain crossing the river at any place, nor is there anything like a true pool, the deep water being found more properly in fissures and pockets. The river bottom is a broad, smooth rock, seamed by a narrow, crooked channel, or in some places several of them, alternately widening and narrowing, shoaling and deepening; nowhere good navigation, but more difficult in some places than in others. The rapids are, therefore, not broken and noisy; but, the descent being gradual, the water flows over its bed in a broad, smooth, unbroken sheet, with nothing but the faintest ripples on its surface to indicate the dangerous places. The casual observer would not suspect the presence of the rapids unless he were notified of their locality beforehand. From these facts it may be readily inferred that boats would not undertake their passage at night, even if the channel were deep and well defined.

The worst parts of these rapids are called, by steamboat and river men, chains, of which there are five principal ones, known as Lower, English, Lamallee's, Spanish, and Upper, respectively. From the Lower to Spanish chain, inclusive, the channel used by steamboats is crooked, shallow, and exceedingly difficult of navigation, requiring, as General Warren states in his report of April 6, 1854, to be excavated "almost continuously to the landing at Nashville, a distance of seven and a half miles." For this distance the fall is about eighteen feet, and the average slope 2.4 feet per mile. From Nashville to the Upper chain the channel is straight and deep, and the fall only four feet, or not more than a foot per mile.

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*Reduced to the low water of 1864.

†This discharge was calculated with a mean depth of 3.9 feet, the average depth at the time the velocity was observed.

The Lower chain extends from Keokuk to the mouth of Price's creek. The channel is 3.5 feet to eight feet deep, but it is very swift and crooked, and therefore intersected by surface and under currents, particularly in that part of it known as Sucker chute and Omega patch. The greater part of the last appropriation was expended here, improving the channel materially, but the fragments of the rock blown out were piled alongside of the channel, injudiciously it appears, as the ice has already carried away the greater part of the piles and redeposited the fragments of rock in the channel.

The English chain extends from Montebello to Waggoner's warehouse. The channel running near the Illinois shore in this reach is comparatively straight, from four to seven feet deep, and from fifty to two hundred feet wide, and presents no particular difficulties to navigation except in times of high wind.

The head of Lamallec's chain is opposite the mouth of Larey's creek; the channel is from 4.5 to 10 feet deep, and an average of one hundred and twenty feet wide; but it is crooked, intricate and dangerous, owing to the presence of many shoal patches of rock, the breaks of which are not distinguishable in rough weather.

Spanish chain extends from Judge Ballinger's place to within a half mile of Nashville; the channel is from three to thirteen feet deep, and from twenty-five to three hundred feet wide, and, although sufficiently difficult of navigation, has been somewhat improved by excavation.

The Upper chain extends but a short distance below Montrose island, and is made by a broad flat bed of rock extending entirely across the river, upon which the water in dry seasons is not over two feet, and frequently not a foot deep. The channel is a channel only in name, being nothing more than a slight depression in the rock about three feet deep and fifty feet wide in the narrowest place. An accurate idea of the geological and other physical features of the entire rapids may be obtained by an inspection of the maps, sections and profiles submitted herewith. The difficulty of navigation, it may be observed on all the chains, lies not so much in the shallowness of the channel or thread of the current as in its unevenness of bottom, insufficient width, tortuous direction, and great velocity. The influence of these features is exaggerated by cross-surface and under currents, and by east and west winds. From fear of the rocks boats are compelled to move slowly, and are therefore more difficult to guide, and no matter how skilful the pilot may be his boat will be carried forward in the direction of the original impulse for some distance before it can be made to obey the helm; this is particularly the case in windy weather and while going down stream. From these causes I am of the opinion that, had a careful record been kept of the boats grounded on the rapids, it would probably show that as many had struck upon the rocks near the pools as on the chains themselves. If this view of the case is correct, no amount of excavation would entirely remedy the difficulty.

The greatest fall on the rapids is on the Lower chain, where it amounts to 1.472 feet in 1,000 feet, or 7.77 feet per mile; the velocity of the current is consequently greater here than at any other place, though it was not accurately measured on account of running ice. The greatest observed velocity was at the head of English chain, where it was found to be 4,35 feet per second, or 3.02 miles per hour.

The maximum range of the water surface at the head of the rapids could not be determined with exactness for the lack of well-defined high water marks, but from the best that could be obtained it is found to be about 12.65 feet. General Warren, in his report of April 6, 1854, gives it at 11.75 feet. The average range will probably not exceed 9 feet. At Waggoner's, Nashville and Keokuk the difference between extreme high and low water was accurately determined, and found to be 15.88 feet and 19.28 feet respectively.

In 1865 and 1866 navigation opened about the 1st of March, and closed about the 1st of December, giving 275 days, which may be considered somewhat above the average for the boating season. By an examination of the register kept at the Keokuk Indicator by the Upper Mississippi Pilots' Association it appears that the water on the Lower chain was less than four feet for fifty days during 1865, the least depth, 2.3 feet, having been reached on the 20th of June; but this was quite an unusual season, the lowest water generally occurring about the middle of September and continuing much longer. During 1866 the same register shows ninety-two days, or one-third the entire season, when the water was less than four feet.

The least available depth recorded was two feet, and occurred on the 4th or 5th of October. From the 28th of September to the 2d of December the water ranged between two feet and 3.3 feet on the Lower chain. This was about an average year. The driest season known was that of 1864, when the river, early in September, reached a stage about ten inches lower than just mentioned. The plane of this low water has been taken as the plane of reference for all the soundings made by the parties under my direction.

During the extreme low water season navigation for steamboats along the rapids is entirely suspended, and their cargoes are transferred either by rail or lighters, at an extra cost of about one dollar per ton and an average cost of about $500 per day to the steamboats themselves while discharging and taking on freight, or about $1,000 per trip. By a register, kept at the Rock Island bridge, it is ascertained that during the period of seven years ending on the 1st day of December, 1866, 2,412 steamboats and 1,363 barges have passed up and down the river. This would be an average of 344 steamboats and 175 barges each way, but the last year shows a large increase in the number of boats of all classes, 677 steamboats having passed up, and 671 having gone down. As many as 600 of these boats, probably, carried their cargoes to the lower rapids; and as we have just seen these rapids had less than four feet water upon them for ninety-two days, and were almost entirely impassable for sixty-four days, it is safe to calculate that the steamboats alone engaged in this commerce were taxed to the amount of $250,000 for extra labor, in order to tranship their freight at the lower rapids,* while the owners of the freight were compelled to pay one dollar per ton in addition for lighterage and railroad charges. What might have been the influence of the rapids in deflecting commerce from its natural channel, or in repressing it altogether, must remain for the present a matter of conjecture, though it is not difficult to demonstrate that the products which have gone to the railroad, in order to reach a market, have cost the producers twenty-five per cent. of their value more than would have been a fair rate for freight by good water transportation. From these facts there can be but little doubt that the Des Moines rapids alone, in their present state, cost the people of the upper Mississippi valley, at the least possible calculation, half a million of dollars annually. As they are a barrier to nearly 40,000 miles of internal navigation, the equivalent of double that many miles of internal coast bordering upon the Mississippi and its navigable tributaries, it is not difficult to see that their improvement is a matter of national import, in which all sections of the country are equally interested. Tabulated statements of the amount of commerce and navigation which would be benefited thereby, as well as the amount of revenue collected at the nearest ports, are submitted herewith, under the head of general remarks.

In carrying out the instructions of the engineer department, heretofore recited, I have endeavored to consult the interests of commerce in its broadest extent, but have listened attentively to every suggestion in regard to the plan and necessity of improvement, whether made by persons locally or generally interested. But before discussing the various plans which have claimed my attention, I desire to state that all the experience of the past goes to show that no plan can be made entirely effective which is based upon temporary expedients, or depends for its execution upon successive appropriations of small sums by Congress, as has been the custom heretofore. Something like $400,000, exclusive of the last appropriation, have been already appropriated for both rapids, $335,000 of which have been expended upon the lower rapids, for which amount not to exceed 25,000 cubic yards of stone have been excavated. As this money was expended when labor was comparatively cheap, it ought to have been sufficient, with a judicious plan of improvement, to do nearly the entire work required. Notwithstanding the work done has benefited the channel, I regard the expenditure as almost thrown away, most of it having been consumed in experiments and preparations.

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* See the certificate of Mr. Griffith, secretary of the Northern Line Packet Company, submitted herewith.

After a feasible plan has been devised, and proper estimates have been made, the necessary money should be appropriated at once, so as to secure the means by which the work may be carried forward vigorously and economically till the improvement is finished.

The plan of excavating the channel is for a variety of reasons exceedingly difficult to execute at these rapids, either by blasting under water or by the use of coffer dams.

In order to enlarge the channel to 200 feet width and four feet depth, at extreme low water, it will be necessary, according to General Warren's report, (making allowance for the ten inches additional depth, not provided for by him, and rendered necessary by the low water of 1864,) to excavate about 150,000 cubic yards of stone. According to the data recently obtained, it will require the excavation of 177,519 82 cubic yards, which. at an average of fifteen dollars per yard, will cost $2,662,797 30.

Should this channel be completed it will not accomplish all that is required, for in addition to the dangers consequent upon cross-currents, it is only indicated by the faintest ripple mark of the running water, and could not, therefore, be used either during the night, in the fog, or during unfavorable winds, and a special pilot would be required at nearly all times. Hence one-half the time of extreme low water the river would still be impassable at the rapids.

Other difficulties would also continue to exist; the fall of eighteen feet in seven and one-half miles, with an increased current, would have to be overcome at a great expense of cost and time by the ascending boats, and the navigation for descending boats would not be shorn of its dangers. In addition to this, as the water is nowhere deep, and as the excavation has to be carried lower than actually required, the tendency is to draw the water from the shores and above, and proportionately transfer the shallow places. From these considerations I do not hesitate to recommend the abandonment of this plan at the lower rapids, and the adoption of another, which will secure safe, easy, and economical navigation at any time of night or day, and in all kinds of weather, for every species of craft plying upon the river, either above or below the rapids. Nothing less than this will fully subserve the interests of commerce or national defence, and therefore nothing else should be adopted. The fullest and most efficient means to overcome the difficulty must ultimately be the most economical, although they might involve the expenditure of a large sum of money. But when those means are found but a little more expensive, as shown herein, as well as much more certain to accomplish the desired result, they should be adopted at once and without further argument.

Several other plans, such as the construction of a continuous dam with locks across the entire stream, and various modifications of wing dams, sluices, and "chutes" for narrowing and deepening the thread of the current, have been suggested and carefully considered, but have all been rejected as involving too many elements of uncertainty to warrant their application to a river of such magnitude as the Mississippi. They are, without exception, more or less experimental in their character, and concerned with elements in the problem quite indeterminate in their value and imfluence, and while some of them might materially ameliorate the present difficulties, the chances in their favor are too uncertain, and their probable cost too much a matter of speculation, to authorize their adoption.

So far as the necessities of commerce are concerned the river has already been sufficiently experimented upon; effective plans are now required.

In view of these facts I have respectfully to recommend the construction of an independent navigation canal along the Iowa shore from a point near the present site of the Keokuk Indicator, at the city of Keokuk, to a point just below the village of Nashville; the balance of the distance to be overcome by using the natural channel, which from here to the Upper chain is found to contain sufficient water for all purposes. At the Upper chain a through cut 200 feet wide, six feet deep, and 2,400 feet long, will be necessary. A careful calculation shows that 54,882.29 cubic yards will have to be excavated, and this can most surely and economically be done by the use of coffer-dams at the low-water season.

The estimated dimensions of the canal are as follows: length 7.6 miles; width on the water surface three hundred feet, and depth at the lowest stage six feet. The stage of water here referred to is that of 1864, which was ten inches lower than any other season recorded and about fifteen inches below that of 1866, which may be taken as an average. The canal would therefore pass boats drawing full six feet, and have a sufficient depth in addition for perfect safety during seasons of average low water. It should run the entire distance, except at one or two low points along the shore in the bed of the river. The river embankment for strength and economy should be constructed of earth, and securely covered inside and out with a well made riprap of broken stone, so as to render it entirely safe against the running ice and freshets. It will require two lift-locks and one guard-lock; the lift-lock to be three hundred and fifty-six feet between the mitre-sills, eighty feet wide beween tops of chamber walls, (seventy-eight feet at the water-surface,) and to lift respectively eight and ten and one-third feet.

The lower lock should also be furnished with a set of guard-gates for security against floods, and the guard-lock proper at the head of the canal should be so arranged as to admit of being used as a lift-lock whenever required, which would be after the water in the river at the head of the canal had raised (three or four feet) above the extreme low-water mark. This construction will admit of nine feet draught, the utmost likely ever to be required for purposes of navigation, either by vessels of commerce or war, and will allow the canal to be used at all ordinary stages of the river, so that ascending boats may avail themselves of the slack water of the canal to overcome the increased currents of high water in the open river. The saving in fuel and time would alone pay a handsome revenue upon the entire cost of the improvement.

It will be observed that in this canal a greater depth at extreme low water is provided for than is required by the present ruling depth of the river above and below; but as the work is intended to be permanent, it should be constructed so as to meet all possible contingencies of the national defence and river improvements in the future.

It is believed that before the expiration of fifty years the average ruling low-water depth of the Mississippi from St. Louis to St. Paul may be increased to six or seven feet, in which event no changes will be necessary in the proposed canal at the lower rapids. This system of navigation, providing in the fullest manner for the improvement of the rapids, will cost $3,390,000. Should it be deemed inadmissible or unnecessary by Congress to provide, in the dimensions of the proposed canal, for the ultimate development of the river above and below, the cost may be reduced to $2,731,722 96, by reducing the depth of water in the channel and through-cut to five feet instead of six, so as to give good navigation for boats drawing four-feet water. This may be ultimately diminished by the sum of $34,155, should it be found unnecessary to construct the stone pier or wing-dam estimated for at the foot of Montrose island.

The through-cut along the channel at the Upper chain involves the use of coffer-dams, and although they are quite expensive in their application, it is believed that they are more likely than any other means to result successfully; but as the work is to be done by contract, the contractor should be permitted to use his own discretion in the selection of the plan, under sufficient bond and surety, for the expeditious excavation of the new channel to the dimensions specified in this report. Estimates of cost and a general plan of the proposed canal, prepared under my directions by my assistant, Mr. D. C. Jenné, a civil engineer of sound judgment and enlarged experience in the construction of canals, together with a map of the rapids and a part of the river above and below, are submitted herewith.

Detailed maps, plans, and specifications will be prepared and forwarded to the engineer department as soon as the more pressing duties with which I am charged will permit.

The following extracts from the report of Mr. D. C. Jenné, embodying sound opinions confirmatory of my judgment, will give all the additional information necessary for a complete understanding of the proposed plan of improvement, viz:

"Your special instructions to me were to make a detailed estimate for a canal three hundred feet wide and six feet deep at low water, (low water of 1864,) with locks three hundred and fifty feet by eighty feet, extending from the deep water at Nashville to the deep water at Keokuk. After a personal examination of the route, I was enabled very carefully to locate on the map which Colonel Ulffers had prepared a centre line of canal, which is generally about one hundred and fifty feet from the shore, except for a distance of 1.44 miles, where it runs on the low table-land adjoining the river. A profile of the surface line of low and high water, and of the ground and the bed of the river, showing both excavation and embankment, has also been prepared. At the head of the canal is located a guard-lock with walls twenty-one and two-thirds feet high, or two feet above high-water mark. This will be used as a lift-lock when the water in the river is more than three feet above low water. It will have a favorable location independent of the river, and the cost of bailing and draining will be comparatively small.

"A lock of eight-feet lift is located at a point about five and six-tenths miles from the upper end and two miles from Keokuk. This lock also has a location independent of the river, and not expensive for bailing and draining.

"At the lower end a lock of 10⅓ feet lift is located entirely in the river, and its construction will require an expensive coffer-dam, and make the item of bailing and draining very heavy. Its location is such as to make six feet of water on the mitre-sill at low water. The walls will be 28⅔ feet high, which will carry them two feet above high water. In the centre is placed an extra set of gates, which reverse in closing to keep high water out of the canal.

"The river bank of the canal for the entire length is to be raised four feet above the high water of 1851, and is to be 20 feet wide on the top, with an outside slope of 1½ to 1, and an inside slope of 1¼ to 1, with a heavy rip-rap wall on the outside, and a higher one on the inside and over the top. The height of the bank will vary from 18 to 30 feet above the bed of the river.

"A large amount of rock excavation will be necessary at the guard-lock, and for one mile below, in order to obtain six feet depth in low water in the river; also at the middle lock and for a half mile below.

"On the flats from four to eight feet of excavation are earth, and the balance rock. The excavated material will generally be used in the embankment and rip-rap walls, and can be hauled from the pit directly to the point required, and thus save the expense of borrowing the materials from other points to form the bank.

"The character of the earth in the adjoining hills or banks is very favorable for forming solid and water-tight banks, but for a considerable part of the distance the rocks run up so high on the hills that it will be expensive obtaining the same, and for this reason a high price has been used in the estimate.

"There is probably no stone on this side of the river that will answer for face stone for the locks, but the backing and vertical wall stone can mostly be obtained here, and perhaps a large portion of the excavated rock can be used for this purpose.

"On the Illinois or east side of the river, within a reasonable distance of the work, are located splendid quarries of magnesian and other limestone, which will answer every purpose for face and dimension stones, and which can be delivered on the ice during the winter, or in boats during the summer.

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"The magnitude of this work is such that the actual cost per mile must far exceed the general cost of most of the canals in this country. The enlarged Erie, with a prism of 56 feet width of bottom, 70 feet surface, and seven feet depth of water, with double locks 110 by 18 feet, has cost about $91,000 per mile. The proposed canal will have a cross section of prism about four times as large as the Erie, with locks three times as wide. The banks will be almost entirely built in the river, with a heavy guard bank to protect against high water, while the Erie canal has comparatively a small amount of this kind of work."

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"I would recommend that the Upper chain be improved by excavating, on the west side of Montrose island, a channel 200 feet wide and six feet deep at low water; and for the purpose of preventing the water from spreading out toward the Nauvoo or east side of the river, for at least half the length of the channel, that a stone pier, extending down from the foot of said island for 1,000 feet, be built parallel with the channel. The excavation can be done by constructing coffer-dams, say three in number, which shall embrace an area of 1,000 by 230 feet each, pumping out the water and excavating the lock by the ordinary process of drilling and blasting.

"If it be necessary to contract the water still further, the excavated material can be used to form a wing dam from the channel to the west shore.

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"From all the information in my possession, it seems that a depth of five feet is all that can be obtained in the river above, until improvements shall be made to increase the same. If the demands of commerce shall ever call for this increased depth, it will seem to have been a great oversight not to have made the improvement of the rapids for six feet depth of water, even though the cost had thereby been greatly augmented. Therefore, in view of what the commerce of the river may hereafter demand, I would recommend that the channel be made six feet deep at low water. This is undoubtedly all that will ever be required, inasmuch as no greater depth can probably be obtained in the river above.

"If a dam were built across the river at Nashville, raising the water four feet, the most of the rock excavation in the canal and a very large part of that in the channel at the Upper chain would be avoided, and the cost of the whole work materially reduced. Such a dam would, however, prevent boats from navigating the river, and compel them to use the canal even when the water in the river is of sufficient depth; it is therefore inadmissible.

"The annexed estimates for the canal are based on 300 feet width and six feet depth, but it will be seen that by reducing the width to 200 feet where the excavation of rock and earth occurs, a saving of $280,000 can be made. This reduction would occur in detached portions, where the canal leaves the river, and in my opinion would answer every purpose. If it should afterwards be considered necessary, the additional 100 feet could be excavated during the suspension of navigation.

"In order to obtain materials for embankment and to locate a good line for the canal, it will be necessary to alter in several places the line of the public highway, and of the Keokuk and Fort Madison railroad. The total length of each which requires alteration is about three miles, and the cost is embraced in the annexed estimates.

"There are several small streams which will have to be taken in, and as the river guard bank must be carried very much above the surface of the water in the canal, no waste-weirs can be constructed at those points. The most important of these streams is Price's creek. If they in times of freshet bring in too much water, it will have to be passed off in sluices which must be constructed around the lift-locks.

"The cost of the sluices is provided for in the estimates."

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TIME REQUIRED TO CONSTRUCT THE WORK.

"In the construction of the canal, the first season should be occupied in excavating a part of the canal, putting in the bottom of the outside of the rip-rap wall for the entire length, and raising it from ten to fifteen feet high. This can be done and allow the high water of the next spring to overflow it and do no harm. During the second year the excavation should be continued, the earth for embankment put in and the outside rip-rap wall completed. The third season the excavation for the canal should be finished, the inside rip-rap wall put in, and the remainder of the bank and walls completed. For the locks, the first season should be occupied in procuring, preparing, and delivering materials at the works. The second season, the coffer-dams should be put in, the lock pits excavated, the foundations prepared, and a portion of the masonry laid. During the third year, the masonry, gates, embankment, and all the other work should be completed. In this manner, if the work is commenced in the ensuing summer, the whole can be completed in the fall of 1869, or in about two and a half years.

"The channel and piers at the Upper chain can be finished by the fall of 1868, or in one and a half year.

COST OF MAINTENANCE.

"The general average cost for the repairs of the enlarged Erie canal, for the last five years, has been about $1,000 per mile per year, including all items of repairs, superintendence, and lock-tending. This canal is about 350 miles long, and has fifty-seven double locks and fifteen single locks.

"It is my opinion that the maintenance of the proposed canal and locks cannot exceed $2,000 per mile per year for the next ten years, and that for the first five years it will not be over $1,000 per mile per year, unless some unforeseen accident shall occur. At this rate the cost of repairs of the whole canal for ten years will be $15,200 per year.

"If the demands of commerce shall ever require a double set of locks, the proposed ones can be so located on one side of the centre as to leave sufficient room for the construction of other locks by their side without in any manner disturbing the outside river embankment wall.

"In the prism of the canal and in the locks, provision is made for a depth of nine feet when there is a rise of three feet in the river, in order that boats of eight feet draught may pass through the canal.

"I have prepared a plan for the lower lock, of the dimensions and form heretofore described, the general details of which, with the exception of the reversed gates, will apply to the other lift-lock and guard-lock. It is supposed that the foundation of all the locks will be on rock of such a character as to obviate the necessity of using timber.

"The gates are to be of wood, properly arched on the upper side and strengthened, with wrought-iron braces or hog-chains on the lower side. This, it is believed, will answer the purpose designed, and the expense will be much less than that of iron gates. It is proposed to hang the gates on the suspension plan which has been successfully applied to the locks on the St. Mary's canal, between Lakes Huron and Superior.

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"Detailed estimates of the cost of all the work are hereunto annexed, of which the following is a

SUMMARY.

"For a canal three hundred feet wide and six feet deep, with a channel at Mont- six feet deep—

Cost of canal, embankment, and walls	$1, 717, 480
Cost of lift-lock	371, 265
Cost of middle-lock	244, 910
Cost of guard-lock	242, 822
Total cost canal and locks	2, 576, 477
Cost of channel and pier at Montrose	619, 155
Total	3, 195, 632
Add contingencies and engineering	194, 368
Total cost	3, 390, 000

"For a canal three hundred feet wide in embankment and two hundred feet wide in excavation, and six feet deep, with a channel at Montrose six feet deep—

Cost of canal embankment and walls	$1, 454, 680
Cost of lower lift-lock	371, 265
Cost of middle lift-lock	244, 910
Cost of guard-lock	242, 822
Total cost canal and locks	2, 313, 677
Cost of channel and piers at Montrose	619, 155
Total	2, 932, 832
Add contingencies and engineering	177, 168
Total cost	3, 110, 000

"For a canal 300 feet wide and five feet deep, with a channel at Montrose five feet deep—

Total for a canal six feet deep and locks, as above	$2,576,477	
Deduct difference in cost for five feet	220,000	
Cost of canal and locks		$2,356,477
Total for channel and pier at Montrose	619,155	
Deduct difference in cost for five feet	157,500	
Cost of channel and pier		461,655
Total		2,818,132
Add for contingencies and engineering		171,868
Total cost		2,990,000

"For a canal 300 feet wide in embankment, 200 feet in excavation, and five feet deep, with a channel at Montrose five feet deep—

Total for canal six feet deep and locks, as above	$2,313,677	
Deduct difference in cost for five feet	220,000	
Cost of canal and locks		$2,093,677
Total for channel and pier, as above	619,155	
Deduct difference in cost for five feet	157,500	
Cost of channel and pier		461,655
Total		2,555,332
Add for contingencies and engineering		154,668
Total cost		2,710,000"

From the foregoing it will be seen that provision has been made in the estimate for the reduction of the canal, where excavation is necessary, to 200 feet in width, should it be deemed advisable; but this is not recommended, since the full width of 300 feet will be required for the meeting of boats and their barges ascending and descending. As the delays are more apt to occur at the locks than elsewhere, the full width should be preserved especially in their vicinity. If the canal for boats of four-feet draught is adopted, its width of 300 feet should be preserved throughout.

THE ROCK ISLAND RAPIDS.

The Rock Island or upper rapids extend from Le Claire to Davenport, a distance of 14.26 miles, measured on the Iowa shore, with a total fall of 21.46 feet. The mean width of the Mississippi in this distance is about 2,500 feet, varying from 1,500 feet (at Port Byron) to 3,960 feet (below Campbell's island.) The area of cross-section varies from 6,829 square feet (on Moline chain) to 21,093 square feet (at the foot of St. Louis chain.) The greatest velocity is on Moline chain, being 5.0545 feet per second, or about 3½ miles per hour, at low water. The least velocity is found opposite Hampton, being not greater than 1½ mile per hour.

The great difference, in hydrographic features, between the Rock Island and the Des Moines rapids must find its explanation in the geological structure of the country. At the Des Moines rapids the river runs over an inclined stratum of a single rock formation, the cherty limestones of the Keokuk series, the dip of which is equal to the present inclination of the water surface. At the Rock Island rapids the geological conditions are entirely different. Here we find, at the head of the rapids, near Le Claire, a magnesian limestone of upper silurian-age, (Niagara group,) about 50 feet thick, dipping to the southward more rapidly than the surface of the water, its top layers disappearing below water near Hampton. Succeeding this, in regular sequence, we find below Hampton limestones of the Devonian age, (commonly referred to as the Hampton group,) the successive ledges of which crop out on both river banks, and occasionally in the river bed, forming reefs or chains.

The consequences of this difference in geological structure are at once apparent in a comparison of the profiles of the two rapids. While in the Des Moines rapids we find a uniform depth and width throughout their entire length, varying only in depth and width of comparatively insignificant fissures or channels, we have in the Rock Island rapids some reefs or chains obstructing navigation for a short distance each, and separated by deep intervals or pools from six to thirty feet in depth. Of the fourteen miles between the head and foot of the rapids, nearly eleven miles afford good navigation in the lowest stages, the obstructed portion covering a distance of only a little more than three miles. At the Rock Island rapids the total descent is about the same as at the Des Moines rapids; but in the latter case it is mostly found in the lower seven miles, whilst in the former it is nearly equally distributed over their entire fourteen miles.

The average length of time when the water is less than four feet on the Moline, the shoalest of the chains, is about ninety days, more than four feet about 180 days, or two-thirds of the average boating season.

From these circumstances, and the reasons set forth in the report of my assistant, Brevet Colonel P. C. Hains, embodied herein, I have the honor to recommend that the navigation of these rapids be improved by excavating the natural channel, so as to give a width of 200 feet and a navigable depth of four feet, at extreme low water, the plane of reference being the low water of 1864. The disparity of cost between this plan and that of a canal leaves no doubt in my mind as to which should be adopted, notwithstanding the fact that the slack-water of the canal would be a great advantage in itself to the boats navigating it.

It is believed that the plan recommended can be executed at these rapids without any extraordinary difficulty; and as the river does not average over 2,500 feet in width, the channel, when completed, will conform to the natural direction of the main current, will be free from hurtful cross-currents, and will not be difficult to follow during the prevalence of unfavorable winds. A few buoys, or pyramids of stone, properly placed, will enable the boats to navigate it during the night. From this it will be seen that the proposed excavated channel promises all that is required. When finished it will be good for all time, will require no attendance or repairs, and will not interfere with any other plan, should the future improvement of the river render a further improvement necessary.

The amount of commerce and navigation interested in the improvement of these rapids is essentially the same as that for the lower rapids, and hence for information on this point I respectfully call attention to the "statement" previously mentioned.

The details of the plan of improvement of the upper rapids are given in the following report of Brevet Lieutenant Colonel Hains:

DAVENPORT, IOWA, *December* 20, 1866.

SIR: In obedience to your orders of the 5th of October, 1866, directing me "to proceed to Davenport, Iowa, for the purpose of making a detailed survey and examination of the Rock Island rapids of the Mississippi river," and of your letter containing more detailed instructions of the same date, I have the honor to submit the following report, with the accompanying drawings:

I left Keokuk, Iowa, on the 6th of October, 1866, arriving in Davenport, Iowa, the next day, and immediately commenced organizing my parties, and in order that the work might be pushed forward with the greatest despatch consistent with the importance of the work, and inasmuch as the season for work would be of short duration, I put into the field all the force that could work to advantage.

The hydrographic party was placed under the immediate charge of Mr. J. E. Abbott, civil engineer. Their work included all that related to the topography of the bed of the river, and other information concerning the flow of the water over the rapids.

A larger party was placed under the charge of Mr. W. D. Clark, civil engineer, with a view of making an accurate survey of the valley on both sides of the river, showing the meandering of the shores, and gathering all other information necessary for the investigation of the several projects for the improvement of the navigation on the upper rapids. Lines of levels were run on both shores, from a point about four miles below Rock Island to a point about four miles above Le Claire; perpendicular offsets connecting with the main line at various distances from 50 to 500 feet apart, according to the changes in the general feature of the shore, were run.

The accompanying maps show the work that has been accomplished, better than any explanation.

As the time allowed us would not warrant an entire resurvey of the bed of the river, and, moreover, as General Warren's map, wherever tested, proved to be sufficiently accurate, I caused Mr. Abbott's party to restrict themselves, at first, more particularly to a thorough examination of the bottom on the chains, in order to get the most accurate possible data for estimating the amount of rock excavation necessary to make a channel of 200 feet width and four feet depth in low water. A favorable season has, however, enabled us to accomplish more hydrographic work than could reasonably have been anticipated.

The upper or Rock Island rapids begin at a point near the lower end of Rock Island, and extend $14\frac{26}{100}$ miles up the river to a point near the lower end of the town of Le Claire. The bed of the river throughout this entire distance consists of a hard surface of limestone rock, worn in many places into deep furrows by the long continued action of the water and the material washed along the bottom. This rock crops out along the shores, and is generally found stratified in thin layers; the lower strata in the bed of the river appear to be harder and of different thicknesses, from four inches to two feet and upwards. There are also a number of large erratic boulders of granite to be met with, but these, as a general thing, do not present serious obstructions, but in some cases, as at Campbell's chain, they rather serve as guide marks for pilots, who would protest against their removal on that account, unless replaced by other equally permanent marks.

The only difficulty in the way of navigating the rapids consists in passing over the chains, of these there are seven, viz: the Upper or Smith's chain, Sycamore, St. Louis, Campbell's, Duck Creek, Moline, and Lower chains. At these places the rocky bed of the river projects out from each shore like a bar, the projecting points sometimes overlapping each other, leaving only a narrow, tortuous channel between them, and in some instances extending like a dam or rocky bar entirely across the river. Between the chains, throughout almost the entire distance, is a wide and navigable channel, with plenty of water for boats that navigate the upper Mississippi, and at such places the velocity of the current is much less than on the chains.

Between the head and foot of the rapids, a distance of a little more than fourteen miles, nearly eleven miles are good navigation in the lowest stages, the obstructed portion covering a distance of only a little more than three miles.

The channel pursued by steamboats, and that followed by rafts, are indicated on the accompanying map. The centre line of the steamboat channel is also shown in profile.

By referring to the map it will be seen that the steamboat channel, beginning at the head of the rapids, runs in close to the Iowa shore, with plenty of water until it strikes the Upper chain, generally called by pilots Smith's chain; here the channel is narrow, crooked, and the current swift, having a velocity of more than three miles per hour. A large reef or rocky bar known as Asprey patch stands in the middle of what would otherwise be a wide channel. This chain is not considered, however, as difficult or dangerous as most of the others.

Passing Smith's chain, the channel inclines gradually toward the Illinois shore, until it comes to Sycamore chain, which is conceded to be the most difficult place to pass on the whole rapids. Here the rocky ledges project out from each shore, leaving between them only a narrow and crooked water-way. The current being swift and the turns short, boats in passing are exposed to strong cross currents, which tend to sweep them on the lower ledge; besides, in one of the sharp bends a deep pocket has been cut, and a large amount of water runs through it, which by its action tends to draw boats into it, where they sometimes become fastened, and to extricate them involves a loss of much time, and is a labor of great difficulty.

The difficulties at Sycamore chain are not the result of a want of sufficient depth of water, for by referring to the profile it will be seen that there is a good depth in the channel, but they arise from its narrowness and crookedness, together with the strong cross current that sweeps over it.

After passing Sycamore chain the channel runs close to the Illinois shore, passing inside of Crab island, where it becomes very narrow, and then inclines towards the Iowa shore, until, at St. Louis rocks, it reaches a point about midway between the Illinois shore and Fulton's island. Passing the St. Louis rocks it again inclines toward the Illinois shore, until it reaches St. Louis chain, where the channel becomes narrow again, but boats that pass the chains above or below this seldom experience great difficulty here. Below this chain the channel opens out gradually into a stretch of three miles, perfectly navigable at all times. In front of Hampton the current becomes quite sluggish.

Opposite the head of Campbell's island the channel crosses Campbell's chain, which is not only crooked and exposed to cross currents, but the rocky ledge extends entirely across the river. In the channel pursued by steamboats across this chain the water is not much deeper than on either side of it. The slough behind Campbell's island is not used for navigation.

After passing Campbell's chain, with the exception of the rocks near Winnebago island, which are somewhat of an obstruction, the channel is wide and easily navigated until it comes to Duck Creek chain, nearly three miles below. Here it is crooked and narrow, so much so as frequently to necessitate the use of anchors at low water for the purpose of working boats through. This is another difficult chain to pass.

Below Duck creek the channel widens out again, giving good navigation, with the exception of one narrow place for about two miles, when it comes to Moline chain. Here again the ledge of rock extends entirely across the river and forms in low water an impassable barrier to boats drawing more than thirty inches. The water passes over this chain at a mean surface velocity of 3.878 feet per second at low water, and a maximum velocity of 5.0545 feet per second, as determined by actual observations with floats.

The dams at Moline and Little Rock island cut off a large body of water that would otherwise flow out of the main channel, and the universal testimony of the pilots establishes the fact that they have raised the water on this chain some ten inches. It is generally conceded that the navigation has been materially benefited in low water, but the increased volume of water has no doubt increased the velocity of the current also. During the low stages, however, when the velocity of the current is less than at high water, this increase is of little account in comparison with the advantages of getting the increased depth.

From Moline chain the channel widens out again, becomes deep, inclining towards the Iowa shore, and is perfectly navigable for the largest boats on the upper Mississippi until it comes to the Lower chain. The channel here is very crooked, but the current is not so swift as on some of the other chains, and consequently not so difficult to pass. This chain is about a half mile above the Chicago and Rock Island railroad bridge, and no more natural obstructions present themselves below this point in the ordinary low stages.

From the above statement of facts it is evident that these rapids are a serious obstruction to navigation; and though a comparatively small sum of money, judiciously expended, would do much to relieve the pressing demands of commerce, they have stood and still stand a barrier to the free and full development of the resources of the great Mississippi valley. True, the States bordering on the river have shown unexampled advances in population, wealth, and prosperity, but it has been in spite of the natural obstacles in their way.

I have no data on which to base an estimate of the loss occasioned by steamboats being delayed on the rapids; they frequently remain fastened on the rocks for days at a time; during the present season, one boat, the "Little Giant," was delayed on the Sycamore chain for ten days. Besides the loss occasioned by delay, there is the danger of loss of life as well as the loss of boat and cargo. All these are arguments that call for improvement in the navigation.

It does not devolve upon me to enter into a discussion of the benefits to be derived from the successful execution of a judicious plan of improvement. It must be evident to all that it has now become an absolute necessity, and some plan must at once be carried out.

The average length of the boating season is about 260 days. During the winter, as a matter of course, navigation is closed by the ice.

When the river is open for navigation, about one-third of the whole time is rendered dangerous by the shoalness of the water on the rapids, and sometimes impassable for boats drawing more than two feet. In the year 1864 the water was lower than had been known before in many years, attaining its lowest point September 2.

From the record of the stages of water kept at the Chicago and Rock Island railroad bridge, it is found that the greatest range between high and low water during the last seven years is fifteen feet and nine and one-half inches, being the high water of 1862 and the low water of 1864, the mean range during the same period being less than twelve feet.

The range between the highest floods and lowest water at other points along the rapids, from the best authority that could be obtained, are at Valley City, opposite Hampton, thirteen feet and eight inches, and at Le Claire twelve feet, which, if correct, shows a diminution of only three feet and nine inches in the fall at high water as compared with that at low.

The average width of the river on the rapids is about one-half mile. At Le Claire it is only fifteen hundred feet in one place, but widens out above and below. Below the rapids the river is wider than on them, as may be seen from the map. A line of levels, from the head to the foot of the rapids, shows a fall of 21.46 feet in a distance of about fourteen miles, or an average fall of 1.53 feet per mile in low water.

The greatest fall is on Moline and Sycamore chains, as may be seen by referring to the accompanying profile.

The area of a cross section at the head of the rapids, where the river is only

1,650 feet wide, is 30,220 square feet; at a point near Sycamore chain 12,408 square feet; at Moline chain 6,829 square feet.

Careful experiments were made on the velocity of the current in order to determine the amount of discharge over the rapids in ordinary low water. For this purpose the stations were taken, and a number of velocities between them, at different distances from the shore, determined by floats; a mean of these was taken as the surface velocity.

The mean area of the two cross sections at the stations was taken as the area of the cross section, and by applying this to D'Aubisson's formula for the approximate discharge of a river, it was found to be 36,456 cubic feet per second. The approximate discharge behind Campbell's island was also determined in the same manner, and was found to be 10,276 cubic feet per second.

With the exception of the places where the bluffs approach close to the river, the banks are usually steep and rocky.

In your letter of instructions I am required to "locate the Chicago and Rock Island railroad bridge on my maps, and ascertain the direction of the current through its bays, and state its general influence on the free navigation of the stream by every kind of craft." The bridge is accurately located on the map of the rapids herewith transmitted, and also on an enlarged scale on sheet No. 2. A series of experiments with floats sunk in the water two feet below the surface were made, and the lines taken by them in floating down the stream carefully fixed by frequent observations with three theodolites.

The course of each is indicated on the map, and by an inspection of it it will be seen that the turn-table pier makes an angle of about sixteen degrees with the direction taken by the floats. This was in low water. The angle of incidence increases as the water rises.

Having obtained data sufficient to enable me to state its general influence on the free navigation of the stream, I found that the subject had been thoroughly investigated by more able engineers in 1859. I refer to the board of topographical engineers convened by an order of the topographical bureau, March 1, 1859, and consisting of Captains Humphreys, Meade, and Franklin, of the corps of topographical engineers. From their report I extract the following, which shows very clearly the influence it has on the free navigation of the river. I need only add that my investigations are confirmatory of their conclusions.

* * * * * *

"The Chicago and Rock Island railroad bridge is thrown from the island of Rock Island to the city of Davenport, Iowa, and it is supported by two stone abutments on the shores, and six stone piers. The spans (five in number) are 250 feet broad, the draw-span being at the water level (9½ feet stage) 117 and 112 feet respectively. The whole length of the bridge is 1,535 feet.

"The piers, except those of the draw, are thirty-five feet long, and seven feet broad at top, and fifty-three feet long, and eleven feet broad at bottom. The two small draw piers thirty-eight feet long, and ten feet broad at the top, and fifty-four feet long, and fourteen feet broad at bottom. The turn-table pier, including the guard pier and starling, is 350 feet long, 40½ feet broad at the top, and 386 feet long, and 45 feet broad at the bottom."

The following is the decision of the board:

"1st. That the railroad bridge which crosses the Mississippi river between Rock Island, in the State of Illinois, and Davenport, in the State of Iowa, is not constructed according to correct principles, reference being had to the interests of navigation.

"2d. The piers of the said bridge are not of the best form, and that there was no practical difficulty in constructing them of the proper form. With the exception of the turn-table pier, the board is of the opinion that the defective form of the piers is a matter of no material importance.

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"3d. The only pier longer than is necessary is the turn-table pier. This pier, in the opinion of the board, should have been constructed no larger than was absolutely necessary to sustain the truss when the draw is open, and protect it from injury from passing boats. It might have been constructed with a length of 295 feet, affording ample support and protection, and being actually 355 feet in length. The difference (sixty-five feet) is unnecessary, and, in the opinion of the board, pernicious. The effect of making it longer than was absolutely necessary is to contract the water way, increase the velocity, narrow the draw-passage, and present more surface for boats to strike against, thus increasing the difficulty of their passage through the draw. In a pier of this size the starling is of importance, and the upper faces of the piers should have been curved surfaces.

"4th. The piers are not placed parallel with the current, but at angles varying from 26 degrees to 14 degrees 30 minutes. The effect of this obliquity is to treble the obstruction to the flow of the water, and, consequently, to affect the increase of velocity in the same ratio. Another consequence is, that the passages of steamboats and rafts through the draw, and between the piers, are rendered much more difficult and hazardous; furthermore, the draw on the Iowa side is rendered useless by the formation of an eddy therein.

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6th. "The eddy on the Iowa side of the turn-table pier, as nearly as could be estimated, is about 100 feet wide at the foot of the pier, and the turbulence, or boiling of the water, extends about 500 feet below. This eddy is constantly varying in its position and dimensions. The effect on the passage of boats ascending and descending is undoubtedly to render them more difficult, on account of the care required to avoid getting one part of the boat in it, when another part of it is in the current of the draw.

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"8th. The bridge is badly located, and, in consequence of this bad location, is a greater obstruction to the passage of steamboats and rafts than would have been necessary, had the location been good. Any site in the vicinity below Rock Island, out of the rapid current, would have been better. The board, having this point in view, examined the line of the ferry between Rock Island city and Davenport, and found there would be no practical difficulty to the erection of a bridge at this site, or near it, which, if constructed upon proper principles, would be of no material obstruction to navigation."

* * * * *

Although there is no evidence of any specific plan having been proposed for the improvement of these rapids, except that of improving the natural channel itself by excavation, so as to give four feet depth in low water, and a passage-way 200 feet in width, several plans have been proposed in a general way for overcoming the difficulties.

It has been proposed to erect dams across the river, with locks for steamboats and chutes for rafts and flatboats, making a slack-water navigation in the river. A careful inspection of the map of the rapids will show that in order to carry out such a plan it will require at least two locks and three dams to avoid overflowing the bottom lands between the river and the bluffs; one dam and lock should be located just above the town of Hampton; the next lock near the city of Rock Island and the Illinois shore, and one dam at the head and another at the foot of Rock island, between it and the Iowa shore. But without making a detailed estimate of the cost of such a plan, it seems to me altogether inadmissible for the following reasons, viz:

1. No craft of any kind, however large or small, could pass up stream without going through the locks. The smallest skiff and largest steamboat would alike be subjected to this inconvenience at all times.

2. It would obstruct the navigation of the river during the time when no difficulties are experienced on the rapids. For five or six months in the year,

or about two-thirds of the navigable season, the river is high enough not to require an improvement, and in order to overcome the natural obstructions during a period of about three months, we would be substituting an artificial one during the other six.

In planning an improvement for the rapids of the Mississippi river, one point must not be lost sight of, viz: the improvement must not of itself become an obstruction, and no plan should be adopted for the improvement of navigation in low water that would be prejudicial to its present state in high water. On this point I am not alone, and respectfully call your attention to the report of the board of engineers, convened at my request and in obedience to your orders, a copy of which is herewith appended.

PLAN OF IMPROVEMENT BY MEANS OF AN INDEPENDENT LATERAL CANAL ON EITHER SIDE OF THE RIVER.

I have no hesitation in saying that in my opinion this plan is far preferable to the foregoing, no matter on which side the canal should be located. Though it has some objections, it recommends itself from the fact that it in no way interferes with the river as it is, and will be navigable at all times, night or day, windy or foggy weather.

I have not made any estimate of the cost of constructing a canal on either side of the river: first, on account of the limited time at my disposal; and second, because I think the time has not yet come when it is necessary to resort to a canal as a means of overcoming the difficulties of navigation on these rapids. It is certain, however, that a canal of the dimensions necessary to accommodate the commerce of this river cannot be built on either side for less than about two and a half million to three and a half million dollars.

The third plan, viz., by improving the natural channel of the river, will recommend itself to all on account of the obvious advantages of having an improvement of this kind free from all tolls and sources of delay. I have already described the difficulties in the way of navigation on the rapids.

Between the chains there are long reaches of navigable river ranging in depth from six feet upwards, the difficulties being confined to the chains almost entirely, a few boulders and patches of rock, which can easily be removed, occurring here and there between them.

As I have already remarked, I think the time has not yet come when a canal is necessary in order to overcome the difficulties of navigation on the rapids, nor is it difficult to see that even a canal improvement would fail to confer all the benefits on commerce that a perfect improvement of the river itself would.

I have conversed with a number of persons interested in the navigation of the upper Mississippi, and they all admit that four feet of water on the rapids is all that is required. In fact, in low stages, boats cannot carry more than from three to four feet above and below, and hence more than four feet on the rapids is unnecessary. As this depth can be had more economically and quickly by the plan of improving the channel than in any other way, and, moreover, as it gives all the facilities that the present commerce demands, I am of the opinion that this is the plan that should be adopted.

If, however, at any future time the navigation of the river should be improved, so as to produce more than four feet above and below the rapids in low water, and consequently to require more than four feet on the rapids, I would recommend the adoption of some other plan, as the amount of excavation in that case (supposing the river was improved so as to secure six feet) would, probably, be so great, as to render its cost far more than the construction of a canal. But let me add, that whatever may be the ultimate demands of commerce, or the ultimate plan that may be adopted to satisfy those demands, this improvement will in nowise be thrown away. It will always be useful, and should, in my opinion, be made, even though a canal were to be built to-morrow.

There are many boats navigating the upper Mississippi that never require more than four feet, and for such this improvement will at all times be ample; besides, it is probable that when more than four feet has been obtained in low water on the bars above and below the rapids, the commerce of this river will be beyond the capacity of any one canal to accommodate.

There are many advantages connected with the channel improvement that do not exist in connection with other plans, and these must all have weight in deciding this question.

It will be free. It will not require an annual appropriation from the general government to keep it in repair, and when completed will be permanent. It will not interfere with a canal improvement in case that should at some future time become advisable or necessary, and, moreover, the benefits arising from this plan will be felt as the work progresses. Every patch of rock removed is that much benefit to navigation, whereas a canal improvement can be of no benefit until completed.

The latter, however, has one advantage, viz., in affording safe navigation in the darkest and stormiest nights.

The principal objection urged against the application of the channel improvement at these rapids is without substantial foundation.

It is feared that by deepening the channel to four feet in low water and widening it to two hundred feet, will increase the capacity of the water-way to such an extent as to draw off from the pools above such an amount of water as to develop new dangers where these heretofore did not exist. But by a careful examination one can scarcely fail to see that this objection is groundless.

At the Upper or Smith's chain, besides removing a few patches of rock that are a source of difficulty, there will be a few points of the projecting ledges cut off as indicated on the accompanying map. The excavated material can be deposited below the last cut in order to check the velocity of the current, and make it conform more to the direction of the channel at this turn. Certainly this can have no prejudicial effects; the channel is already deep enough, the difficulty being in making the sharp turns.

At Sycamore the cutting will be almost entirely from the projecting ledges, and the material can be used in closing the deep pocket that runs off towards Mechanic's Rock, which produces a strong cross-current and carries off an immense volume of water from the main channel.

The amount of water cut off from this pocket will more than compensate for the increased capacity of the new channel.

The other cuts between this chain and Campbell's are so slight as to render their consideration unnecessary.

At Campbell's chain there will be a long cut, and the capacity of the new channel here will doubtless be increased, but the current is not rapid, and by closing the slough behind Campbell's island, (which, as I have already remarked, is not used for navigation,) with the excavated material a much larger volume of water can be thrown into it than its increased capacity can carry off.

I should have mentioned that by closing this slough behind Filton's island some benefit would doubtless be felt in the raft channel and on St. Louis chain.

At Duck Creek chain we cannot compensate for the increased capacity of the new channel by closing up sloughs in its vicinity, but we can accomplish the same end by depositing the excavated material in the river in the form of a dam, and thus throw into it any amount of water that may be necessary.

At Moline chain the slough behind Rock island has already been practically closed by the Moline dam, and according to the testimony of pilots the depth of the water in the chain has been increased at least ten inches.

There is no doubt but that the removal of a portion of this reef, as it extends entirely across this river, will affect in a slight degree the level of the water for a short distance above, and may necessitate the removal of a few rocks. But the upper edge of the reef where the channel crosses it slopes off into deep water, as may be seen by referring to the accompanying profile of the channel.* By means of a dam made of the excavated material, sufficient water can be thrown into the new channel to more than compensate for its increased capacity of discharge.

The water-way across this reef will be increased in cross sectional area some three hundred square feet, but the material taken out would make, if desired, a dam of loose stone four feet high that would extend entirely across the river. The excavated material can, in each and every case, be disposed of during the operation of the work for closing lateral channels to compensate for the extra quantity of water that would otherwise be drawn off. The places at which the excavation is recommended are shown on the map of the rapids transmitted herewith, and the estimated amount at each place in the annexed tabular statement.

Believing that the plan of improving the natural channel of the river is the one that should at the present time be carried out at these rapids, and also that the practicability of getting four feet water in the lowest stages for a channel of two hundred feet in width is beyond question, I desired to have my views strengthened if they were correct, or their fallacy demonstrated if not; for this purpose I requested that a board be convened, consisting of civil engineers in the government service, for the purpose of considering some of the proposed plans of improvement.

The report of the board I enclose herewith.

In regard to the condition and influence of the dams at Rock island, and as to whether or not they can be continued for mill purposes, without injury to navigation: The dams are located on the map accompanying this report; their influence on navigation has been noticed. These are without a benefit to navigation on Moline chain. Their removal is not necessary, but, on the contrary, they had better remain. I would suggest, however, that in low stages they should not be permitted to consume more water than passes through them under existing circumstances. In high stages it makes no material difference.

I have carefully considered the means by which the excavation in the channel can be effected in the most economical and at the same time expeditious manner. Rock excavation in running water is a difficult undertaking in any case. A comparison with the cost of excavation at the lower rapids by Lee and Floyd can scarcely be instituted as a basis for the same operation here. In the cases referred to the larger portion of the money was expended in preparing machinery, and when the work was well under way the appropriations ceased. The consequence, as might be expected, was, a large sum of money expended and but little work accomplished.

In estimating the cost of excavation at these rapids I have endeavored to ascertain as nearly the actual sum required as possible, and have taken into consideration the delays occasioned in removing working parties from one point to another, the difficulties of the position, and the character of the rock to be excavated. I unhesitatingly recommend the use of coffer-dams at all points where the amount to be excavated will warrant its expenses, as the most satisfactory and certain in its results of any plan yet proposed.

These points are indicated in the tabular statement above referred to.

The following figures represent the plan, elevation, and section of a coffer-dam, on which the estimates for coffer-dams are based. It consists of two rows of two-and-a-half-inch iron rods driven into holes drilled in the rock, the distance between the rows and the rods themselves being each five feet; they are braced and tied by diagonal iron bars, as indicated in the plan. The interior and exterior rows of sheeting piles consist each of two rows of two-inch plank inserted between the wale or string-pieces, and breaking joints with each other; the number of string-pieces may be increased or reduced, as the case seems to require. The holes into which the main piles are driven should be one and a half foot deep and drilled somewhat smaller than the piles themselves, the latter being driven into them. Between the piles there is five feet of puddling. To give additional stability to the dams they should be securely braced from the inside whenever necessary.

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* In making this cut, the slope of the water surface will be lessened, and the area of the cross section increased. These are variable elements that enter into the problem of discharge, and would probably neutralize each other, so that the velocity and discharge would remain sensibly what they were before.

Statement exhibiting the amount of rock to be excavated in order to make the present channel two hundred feet wide and four feet deep in low water, and the estimated cost of excavating at the various places.

Locality.	Number of cubic yards to be excavated.	Cost of excavation per cubic yard.	Length of coffer-dam to be used.	Cost of coffer-dam per linear foot, including construction, pumping, &c.	Total cost of excavation.
SMITH'S CHAIN.			*Feet.*		
Point A	20	$10 00			$200 00
B	755	10 00			7,550 00
C	1,357	10 00			13,570 00
D	246	10 00			2,460 00
E	80	10 00			800 00
Ospreyt's patch*	1,970	10 00			35,460 00
Point F	652	10 00			6,520 00
G †	2,277	4 50	1,100	$25 00	37,746 00
H	296	10 00			2,960 00
Total	7,653				107,266 50
SYCAMORE CHAIN.					
Point A	955	10 00			9,550 00
B	1,630	12 00			19,560 00
C	160	10 00			1,600 00
D	212	14 00			2,968 00
E ‡	5,416	4 00	1,500	25 00	59,164 00
F	1,037	14 00			14,518 00
G	1,008	14 00			14,112 00
H	886	12 00			10,632 00
I ‡	1,632	5 00	300	25 00	15,660 00
J*	338	17 00			5,746 00
K*	109	19 00			2,071 00
Total	13,383				155,581 00
CRAB ISLAND.					
Patch A	83	15 00			1,245 00
B	1,000	15 00			15,000 00
Point C	200	10 00			2,000 00
D	502	10 00			5,020 00
Total	1,785				23,265 00
ST. LOUIS CHAIN.					
Point A	211	10 00			2,110 00
B	689	10 00			6,890 00
Total	900				9,000 00
CAMPBELL'S CHAIN.					
Boulder A	3	20 00			60 00
Centre patch B	637	15 00			9,555 00
Boulder C	5	20 00			100 00
D	4	20 00			80 00
Point E ‡	4,423	4 00	3,000	25 00	102,788 00
F	2,524				

* Very difficult to work at. † Coffer-dam can be used to advantage. ‡ Coffer-dam to be used.

Statement exhibiting the amount of rock to be excavated, &c.—Continued.

Locality.	Number of cubic yards to be excavated.	Cost of excavation per cubic yard.	Length of coffer-dam to be used.	Cost of coffer-dam per linear foot, including construction, pumping, &c.	Total cost of excavation.
CAMPBELL'S CHAIN—Continued.			*Feet.*		
Point G	60	$15 00	....	....	$900 00
H, H' H"	15	20 00	....	....	300 00
I	36	12 00	....	....	432 00
J	260	15 00	....	....	3, 900 00
Total	7, 967	....	....	....	118, 115 00
FROM CAMPBELL'S TO DUCK CREEK.					
Centre patch A	118	12 00	....	....	1, 416 00
Patch B	41	12 00	....	....	492 00
C	55	15 00	....	....	825 00
D	47	15 00	....	....	705 00
E	64	15 00	....	....	960 00
Boulder F	5	20 00	....	....	100 00
Patch G	35	12 00	....	....	420 00
H	18	15 00	....	....	270 00
I	33	12 00	....	....	396 00
J	55	12 00	....	....	660 00
Total	471	....			6, 244 00
DUCK CREEK CHAIN.					
Point A	569	10 00	....	....	5, 690 00
B	592	10 00	....	....	5, 920 00
Through-cut C*	5, 258	5 00	1, 100	$25 00	53, 790 00
Point D	1, 178	10 00	....	....	11, 780 00
E	40	12 00	....	....	480 00
F	2, 180	10 00	....	....	21, 800 00
Total	9, 817	....	....	....	99, 460 00
MOLINE CHAIN.					
Patch A	200	12 00	....	....	2, 400 00
Through-cut B	12, 215	4 00	3, 000	25 00	123, 860 00
Patch D	118	14 00	....	....	1, 652 00
E	15	20 00	....	....	300 00
F	233	16 00	....	....	3, 728 00
Total	12, 781	....	....	....	131, 940 00
LOWER CHAIN.					
Point A	1, 347	10 00	....	....	13, 470 00
B	380	10 00	....	....	3, 800 00
C	948	10 00	....	....	9, 480 00
Patch D	8	20 00	....	....	160 00
E	5	20 00	....	....	100 00
F	6	20 00	....	....	120 00
Total	2, 694	....	....	....	27, 130 00

* Coffer-dam to be used.

From the foregoing we obtain the following as the estimated cost to improve the natural channel of the rapids:

Smith's chain	7, 653	cubic yards	$107, 266 50
Sycamore chain	13, 383	"	155, 581 00
Crab island	1, 785	"	23, 265 00
St. Louis chain	900	"	9, 000 00
Campbell's chain	7, 967	"	118, 115 00
Campbell's chain to Duck creek	471	"	6, 244 00
Duck Creek chain	9, 817	"	99, 460 00

Moline chain	12,781	cubic yards	$131,940 00
Lower chain	2,694	"	27,130 00
	57,451	"	678,001 50
Add for contingencies 20 per cent			135,600 30
Total			813,601 80

Average cost of excavation, $14 16 per cubic yard.

It may appear at the first glance that the percentage which I have added for contingencies in excavating is rather large, but after a careful consideration of the subject I can only say I am convinced that it is not. Experience has taught me that in excavating rock at the lower rapids the cost is materially affected by the more or less favorable seasons for working; and, moreover, the rock being in strata of various thicknesses, if in deepening a part to four feet we should come to a stratum two feet thick, the entire stratum must be taken out. The estimate I consider as small as can reasonably be expected to execute a work of such magnitude; at the same time I am of the opinion that the work is of such importance as would justify the expenditure of treble that amount.

I will only add that I consider promptitude in engaging on this work, and energy in prosecuting it, of vital importance. If it is to be done at all it should be done promptly. Every moment lost is a loss to commerce and to the country.

Estimate of the amount that can be advantageously expended in the fiscal year ending June 30, 1867, $100,000; amount that can be advantageously expended in the fiscal year ending June 30, 1868, $500,000.

This estimate is based on the fact that economy requires that the most important portions of the work, as that of Sycamore and Moline chains, for instance,, when once begun should be pushed forward to completion at once, so as not to necessitate the expense of coffer-dams twice in the same place. The balance to be appropriated and used in removing those points of the least difficulty and during the succeeding low-water season.

Very respectfully, your obedient servant,

PETER C. HAINS,
Captain of Engineers, Brevet Lieut. Colonel U. S. A.

Brevet Major General J. H. WILSON, U. S. A.,
Lieut. Colonel 35th Infantry, in charge of the
Des Moines and Rock Island rapids improvement.

Proceedings of a board of engineers convened at the United States engineers' office, at Davenport, Iowa, on the 19th day of December, 1866, in obedience to the accompanying order.

U. S. ENGINEERS' OFFICE,
DES MOINES AND ROCK ISLAND RAPIDS IMPROVEMENT
AND ILLINOIS AND ROCK RIVER SURVEYS,
Davenport, Iowa, December 19, 1866.

At the request of Brevet Lieutenant Colonel P. C. Hains, captain of engineers, in charge of the Rock Island rapids survey, a board of engineers will convene at this office, at 7 p. m. to-day, for the purpose of considering and recommending a plan of improvement for the above-mentioned rapids.

Detail for the board.—1. Brevet Lieutenant Colonel P. C. Hains, captain of engineers; 2. Mr. James Worrall, civil engineer, assistant; 3. Mr. D. C. Jenné, civil engineer, assistant; 4. Mr. W. F. Shunk, civil engineer, assistant, who will act as recorder.

J. H. WILSON,
Lieutenant Colonel 35th Infantry, Brevet Major General U. S. A.

The board met in pursuance of the above order, and having carefully investigated the advantages and disadvantages of the various plans proposed for the improvement of the Rock Island rapids, recommend the following:

1. That the present steamboat channel be enlarged, by excavation, to a minimum width of 200 feet, and a navigable depth of four feet at the time of low water, which is somewhat greater than the ruling depth in the river north and south of the rapids during that season.

This recommendation is made in view of the economical execution of the work and the present demands of commerce.

Should the ultimate interests of commerce demand a greater depth than four feet, as it would in case a greater depth could be obtained above and below these rapids, the plan of an independent canal and locks without dams would then best promote that interest, the practical result of such a plan being beyond question.

2. That the excavated material be so deposited in the river bed as to check cross-currents and confine the volume of water as far as practicable to the new channel.

3. That coffer-dams be used in carrying on the work, more particularly, however, at Moline and Campbell's chains. From the best information we can obtain they can be put in by the first of September, the period of low water beginning about this time, leaving at least three and a half months for taking out the material; but as the work is to be done by contract, the mode of operation may be left, to a great extent, to the contractor.

4. That the work should not be entered upon until an appropriation be made which will cover its estimated cost, experience having shown that small consecutive appropriations, in such cases, augment the ultimate expense beyond all reasonable calculation and are virtually thrown away in mere preparation.

5. That the improvement which has been proposed by means of locks and dams across the river is inadmissible. It would erect an obstruction permanent throughout the year, whereas at high and ordinary stages no hindrance to navigation now exists.

PETER C. HAINS,
Captain Engineers, Brevet Lieut. Col. U. S. A.
JAMES WORRALL,
Civil Engineer.
DANIEL C. JENNE,
Civil Engineer.
W. F. SHUNK,
Civil Engineer.

GENERAL REMARKS UPON THE NECESSITY OF IMPROVING THE UPPER AND LOWER RAPIDS, BASED UPON STATISTICAL AND COMMERCIAL DATA OBTAINED FROM OFFICIAL DOCUMENTS AND OTHER SOURCES.

The five States, Illinois, Missouri, Wisconsin, Iowa, and Minnesota, bordering on the Mississippi river are agricultural States, the great staples of which consist of wheat, corn, beef, and pork. They annually furnish from one-third to one-half of all the produce grown in the United States, viz: Wheat, 66,105,786 bushels, or about one-half the entire crop; corn, 244,986,768 bushels, or about one-half the entire crop; cattle, 2,526,979 head, or about one-third the entire crop; hogs, 4,896,506 head, or about one-third of the entire crop; or, in value, $677,560,204. Add to this the value of the mining, manufacturing, and mechanical products of these States, valued at $204,150,000, and we have a total of $881,710,204.

In the years 1861–'62–'63 the average yearly tonnage of all American vessels engaged in trans-oceanic commerce, and entering the ports of the United States, was 2,564,252 tons, and the average tonnage of all the vessels of the various countries engaged in oceanic commerce, and entering the ports of the United States, was 5,341,867 tons. Now the three staples contributed by the five upper Mississippi river States just mentioned, to our exports, were equivalent to 1,315,000 tons annually. They therefore not only contributed one-third in value to our entire exports, but gave employment upon the ocean to more than one-half of our entire American tonnage, which was equivalent to one-fourth of all the tonnage of all our trans-oceanic commerce.

New York city is the controlling market for the States, and the value of the surplus products of the different sections are practically regulated by the market value of those products in New York. Accordingly, we usually find the price of wheat, corn, or pork at any particular place to be the respective price of those articles at that time in New York, less the cost of transportation thither. It is the cost of transportation that absorbs the profit on the produce.

There are but two convenient routes of water transportation to New York, one from St. Paul by way of the great lakes and the New York canals, the other by way of St. Louis and New Orleans. The latter route is materially affected by the upper and lower rapids. Losses by detention and accidents on the lower rapids alone are estimated at $500,000 yearly, and to cover extra hazard by these obstructions an additional insurance of thirty to fifty per cent. of the usual rates is asked.

If it were not for these obstructions, transportation by way of the Mississippi would be decidedly the cheaper, as appears from the following table:

The shipment of a bushel of wheat from St. Paul to New York costs:

Via Chicago:

Freight from St. Paul to Chicago	$0 32
Transfer at Chicago	2
Freight to Buffalo, New York	10
Transfer at Buffalo	2
Freight from Buffalo to New York	24
	70

Via St. Louis with the rapids improved:

Freight from St Paul to St. Louis	$0 15
Transfer at St. Louis	3
Freight from St. Louis to New Orleans	12½
Transfer at New Orleans	2½
Freight from New Orleans to New York	20
Extra insurance	2
	55

being a saving of at least fifteen cents per bushel in favor of the latter route, and giving to the produce the benefit of it, as well as a choice of markets.

The upper Mississippi valley in particular finds in the Mississippi river its only natural outlet for commerce, and, in spite of the present obstructions, employs a large amount of tonnage, as shown hereafter; and as this river is the only highway which is perfectly free to all classes of commerce and every species of craft, its improvement is a matter of interest to every citizen who lives in the region bordering upon it or its tributaries.

From official statistics it appears that of all the flour, wheat, corn, oats, barley, hay, hemp, tobacco, and pork (valued at $235,873,878) which found a market at St. Louis during the year 1865, nearly seven-tenths were received from the upper Mississippi States, by the river, and only one-sixth came from other sources.

Mr. Howard, the collector of that port, states officially that $780,706 97 were collected by him for duties on imports during the fiscal year ending September 30, 1866.

It is further stated by Mr. Egbert Dodge in his report to the board of directors of the Union Merchants' Exchange, St. Louis, that important diversions from the river are made at La Crosse, Prairie du Chien, Dunleith, and Rock Island, amounting in the shipments of flour, corn, barley, oats, hay, and cattle, to the east by rail, to *eight-tenths of the entire surplus of the region;* while the shipment by the river south, comprises only one-fifth. The chief reasons for this deflection are the existing obstructions at Davenport and Keokuk, though it cannot be denied that other important laws of trade are exerting their influence in the same directions.

The means of transportation, as steamboats, barges, &c., are corresponding in extent to the considerable trade of the upper Mississippi valley.

From a statement prepared by Mr. James F. Griffith, secretary of the Northern Line Packet Company, we find that in December, 1865, there were 910 steamers, with an aggregate of 216,067.83 registered tonnage, and valued at $24,556,600, on the Mississippi river and its tributaries.

Plying on the upper Mississippi alone there were 304 steamers, with an aggregate registered capacity of 96,296.86 tons and valued at $10,556,600.

From this it will be seen that the upper Mississippi gives employment to one-third of all the steamers on the Mississippi and its tributaries, with nearly one-half of all the tonnage.

This statement is not far from the truth, as the collector of the port of St. Louis alone certifies to 93,607.33 tons in steamers, and 13,055.69 tons in flats, barges, &c., or a total of 106,663.02 tons registered during the fiscal year ending September 30, 1866.

The number of barges, lighters, and similar craft used as auxiliaries is very large, but the enrolling of such being a new though advisable regulation, the compilation of the same was not carried out.

The importance of the upper Mississippi is likewise shown by the following data:

In 1865 there were 3,823 arrivals of steamers in St. Louis, with a capacity of 1,229,826 tons, of which the upper Mississippi valley contributed 827, with a tonnage of 265,467 tons, or three-tenths of the whole; and of 2,953 departures, there were 811, or three-tenths, for the upper Mississippi ports.

In 1866 the arrival of steamers at St. Louis was 2,972, with a tonnage of 1,227,078 tons, of which the upper Mississippi contributed 917 arrivals, with a tonnage of 377,804 tons, or four-tenths of all arrivals. The total of departures from St. Louis was 3,066, of which 943, or three-tenths, were for the upper Mississippi valley.

In 1866 no less than 677 steamers and 389 barges, going up stream, and 671 steamers and 365 barges, going down stream, passed through the Rock Island railroad bridge.

Besides all this there is about 400,000,000 feet of lumber annually which finds its way to market on the Mississippi. Not less than two per cent. is added to the price of lumber on account of dangers and delays in passing the obstructions at the rapids.

Contemplating the immense trade of the upper Mississippi valley, through its natural channel, the Mississippi river, we must come to the conclusion that the obstructions at Keokuk and Davenport are the great drawback of the growing States bordering on the river, and that the damaging influence of those rapids must necessarily increase with the constantly increasing population.

To represent the necessity of the proposed improvement in dollars and cents is, from the nature of the problem, simply impossible, but it is believed that sufficient statistics are embodied herein to show that the work is national and not local or sectional. A simple calculation will show that the improvement of the rapids of the Mississippi will decrease the cost of transportation, by increasing competition between the carriers; thus adding greatly to the wealth of the entire northwest, and removing an oppressive tax from the eastern consumers of its products. Every farmer, manufacturer, and mechanic who depends upon the Mississippi river for the transportation of his produce to market, or who consumes a single article of foreign growth or manufacture, will get more for what he sells and give less for what he buys, when the navigation of the river shall have been made safe, easy, and economical. This being true, the people of the eastern States are nearly as deeply concerned in these improvements as those of the western. The Mississippi river is a great national highway, which cannot become the exclusive property of any chartered company, and therefore it must forever remain free to all classes of commerce and all species of craft.

The dangerous places of the sea-coast are marked by light-houses, and provided with harbors of refuge at the national expense, for the benefit of commerce not exclusively our own. It seems, then, no more than justice that the general government should authorize and provide the means for the improvement of a river in which our own people are exclusively interested, and in the navigation of which nearly every material interest of the entire country is intimately concerned.

I am, general, very respectfully, your obedient servant,

J. H. WILSON,
Lieut. Colonel 35th Infantry, Bvt. Maj. Gen. U. S. A.

Brevet Major General A. A. HUMPHREYS,
Chief Engineer U. S. Army, Washington, D. C.

A.

Estimate of the cost of constructing 7.6 *miles of canal from Nashville to Keokuk, for the improvement of the Des Moines rapids.*

For a canal 300 feet wide and six feet deep, including the necessary protection walls:

Grubbing and clearing	$3,000
1½ miles of bailing and draining, including coffer dams, at $30,000	45,000
304,000 cubic yards excavation of rock, at $2	608,000
437,000 cubic yards excavation of earth, at 40 cents	174,800
674,000 cubic yards embankment, at 50 cents	337,000
400,000 cubic yards embankment hauled from excavation, at 25 cents	100,000
10,000 cubic yards lining, at 60 cents	6,000
50,000 cubic yards puddling, at 25 cents	12,500
143,000 cubic yards loose stones and riprap wall, at $1 50	214,500
200,000 cubic yards riprap wall, made from rock excavation, at 75 cents	150,000
1,000 cubic yards slope and pavement wall, at $2	2,000
5,000 cubic yards vertical wall laid in hydraulic cement, at $5	25,000
3,170 cubic yards vertical wall laid dry, at $4	12,680
3 miles changing line of railroad, at $8,000	24,000
3 miles changing line of public road, at $1,000	3,000
Total	1,717,480

For a canal 300 feet wide in embankment, 200 feet wide in excavation, and six feet deep:

Grubbing and clearing	$3,000
1½ miles bailing and draining, including coffer dams, at $30,000	45,000
200,000 cubic yards excavation of rock, at $2	400,000
300,000 cubic yards excavation of earth, at 40 cents	120,000
674,000 cubic yards embankment, at 50 cents	337,000
400,000 cubic yards embankment hauled from excavation, at 25 cents	100,000
10,000 cubic yards lining, at 60 cents	6,000
50,000 cubic yards puddling earth, at 25 cents	12,500

143,000 cubic yards loose stone and riprap wall, at $1 50	$214,500
200,000 cubic yards riprap wall made from excavation, at 75 cents	150,000
1,000 cubic yards slope and pavement wall, at $2	2,000
5,000 cubic yards vertical wall laid in hydraulic cement, at $5	25,000
3,170 cubic yards vertical wall laid dry, at $4	12,680
3 miles changing line of railroad, at $8,000	24,000
3 miles changing line of public road, at $1,000	3,000
Total	1,454,680

Estimate of the cost of constructing the lower lock, of 10½ feet lift, for the improvement of the Des Moines rapids.

Grubbing and clearing	$100
Bailing and draining, including expenses of coffer dams	40,000
10,860 cubic yards of excavation of rock, at $3	32,580
1,000 cubic yards of excavation of earth, at 60 cents	600
60,000 cubic yards of embankment, at 50 cents	30,000
5,000 cubic yards lining, at 75 cents	3,750
10,000 cubic yards puddling earth, at 30 cents	3,000
1,000 cubic yards slope wall and pavement, at $2	2,000
1,000 cubic yards loose stone, at $1 50	1,500
5,000 cubic yards vertical wall in hydraulic cement, at $6	30,000
550 cubic yards vertical wall laid dry, at $4 50	2,475
13,256 cubic yards masonry in lock walls, at $13	172,328
500 cubic yards concrete masonry, at $6	3,000
127,200 feet, board measure, white oak lumber and planks, at $100 per M	12,720
60,000 feet, board measure, white pine lumber and plank, at $60 per M	3,600
109,000 pounds wrought iron, at 18 cents	19,638
42,000 pounds cast iron, at 12 cents	5,064
5,000 pounds spikes and nails, at 12 cents	600
160 lineal feet snubbing posts, at $1	160
Sulphur and sand cement for irons let into masonry	500
Painting upper part of lock gates	150
130 lineal feet superstructure for draw bridge, at $50	6,500
Fixtures for opening and closing gates	1,000
Total	371,265

Estimate of the cost of constructing middle lock, 8 feet lift, for the improvement of the Des Moines rapids.

Grubbing and clearing	$300
Bailing and draining, including expenses of coffer dams	10,000
19,300 cubic yards excavation of rock, at $2 50	48,250
19,200 cubic yards excavation of earth, at 50 cents	9,600
12,000 cubic yards embankment, at 50 cents	6,000
4,000 cubic yards lining, at 75 cents	3,000
8,000 cubic yards puddling earth, at 30 cents	2,400
500 cubic yards slope wall and pavement, at $2	1,000
800 cubic yards loose stone, at $1 50	1,200
2,500 cubic yards vertical wall in hydraulic cement, at $6	15,000
300 cubic yards vertical wall, laid dry, at $4 50	1,350
8,652 cubic yards masonry in lock walls, at $13	112,476
300 cubic yards concrete masonry, at $6	1,800
64,000 feet, board measure, white oak lumber and plank, at $100 per M	6,400
42,000 feet, board measure, white pine, at $60 per M	2,520
64,300 pounds wrought iron, at 18 cents	11,574
27,500 pounds cast iron, at 12 cents	3,300
4,000 pounds spikes and nails, at 12 cents	480
160 lineal feet snubbing posts, at $1	160
Sulphur and sand cement for irons let into masonry	500
Painting upper parts of gates	100
130 lineal feet superstructure for drawbridge, at 50 cents	6,500
Fixtures for opening and closing gates	1,000
Total	244,910

Estimate of the cost of constructing a guard-lock at the head of the canal, for the improvement of Des Moines rapids.

Grubbing and clearing	$300
Bailing and draining, including expenses of coffer-dam	13,500
19,300 cubic yards excavation of rock, at $2 50	48,250
19,200 cubic yards excavation of earth, at 50 cents	9,600
12,000 cubic yards of embankment, at 50 cents	6,000
4,000 cubic yards of lining, at 75 cents	3,000
8,000 cubic yards of puddling earth, at 30 cents	2,400
800 cubic yards of slope wall and pavement, at $2	1,600
1,000 cubic yards of loose stone, at $1 50	1,500
1,500 cubic yards of vertical wall laid in hydraulic cement, at $6	9,000
400 cubic yards of vertical wall, laid dry, at $4 50	1,800
8,586 cubic yards of masonry in lock walls, at $13	111,618
400 cubic yards of concrete masonry, at $6	2,400
74,000 feet, board measure, of white oak timber and plank, at $100 per M	7,400
9,000 feet, board measure, of white pine timber at $60 per M	540
68,300 pounds of wrought iron, at 18 cents	12,294
24.000 pounds of cast iron, at 12 cents	2,880
4,000 pounds of spikes and nails, at 12 cents	480
160 lineal feet snubbing posts, at $1	160
Sulphur and sand cement for irons let into masonry	500
Painting upper parts of gates	100
130 lineal feet superstructure for drawbridge, at 50 cents	6,500
Fixtures for opening and closing gates	1,000
Total	242,822

Estimate of the cost of excavating a channel and constructing a pier at the Upper chain, near Montrose island, for the improvement of Des Moines rapids.

Channel 200 feet wide and 6 feet deep:

Bailing and draining, including the expenses of constructing and removing coffer dams	$130,000 00
65,000 cubic yards of rock excavation, at $7	455,000 00
Total for channel	585,000 00

Construction of pier from foot of island:

Bailing and draining	$10,000 00
1,208 cubic yards of masonry in pier, at $10	12,080 00
350 cubic yards coping to pier, at $20	7,000 00
11,600 pounds wrought iron dowels and clamps, at 15 cents	1,740 00
667 putting dowel clamps into masonry, at $3	2,001 00
667 putting dowel clamps into masonry, at $2	1,334 00
Total for pier	34,155 00
Total for channel and pier	619,155 00

Channel 200 feet wide and 5 feet deep:

Bailing and draining, including coffer dams	$130,000 00
42,500 cubic yards of rock excavation, at $7	297,500 00
Total for channel	427,500 00
Add for pier at foot of island, as above	34,155 00
Total for channel and pier	461,655 00
Difference of cost	$157,500 00

B.

GEOLOGY OF THE DES MOINES RAPIDS.

The rocks exposed along the Des Moines rapids consist of seven distinct groups, which, although subject to considerable local changes, are easily distinguished from each other. Six of them unquestionably belong to the carboniferous or mountain limestone series; the seventh or highest, I think, can be proven to belong to the coal measures.

I. Cherty limestone, forty feet or more thick, is exposed all along the rapids on both shores, and forms the bed of the river. It consists of thin beds of hard gray limestone interstratified with bands of chert. It is worthless for any purpose except for forming riprap embankments.

II. The Keokuk limestone proper, twenty feet thick. It should be included in limestone I, as it presents all its characteristics, only some of the layers are locally developed into considerable thickness and furnish valuable building stone. It has been extensively quarried near Nauvoo and Keokuk. The following is a description of the "temple quarry," near Nauvoo, where this group attains its fullest development.

The lowest bed, resting directly on the cherty limestone, is a solid layer of two feet four inches thick, very hard and compact, light gray, semi-crystalline, without any chert or spur, and contains but few fossils. This is a very durable and beautiful rock. Separated from this by two feet four inches of shaly limestone and marl, is another good bed of limestone three feet two inches thick, in two layers, similar to the lower one, but rather inferior on account of a greater number of fossils, especially orthisimas, which tend to laminate the rock. Above this, separated by two feet of shaly limestone, is a bed of dark gray limestone, four feet two inches thick, in five layers, very hard, regularly bedded, and well adapted for all purposes where no considerable thickness is required. It would make splendid caps and sills.

Similar quarries have been opened at and near Keokuk, and it would be easy to point out localities between the two places where the same quality of rock could be obtained. But none of these layers are permanent, they thin out or change into shaly and chert limestone, and can only be relied on for a limited space. In the Keokuk quarries the finest blocks are frequently spoiled by cavities containing calcite and beautiful crystals of zincblende.

III. This is the well-known "geode bed" about fifty feet thick, consisting of marls, clays, and irregular patches of thin bedded buff limestone. It will furnish a very good, abundant, and easily accessible material for embankments, but is otherwise perfectly useless.

IV. There are seventeen feet of arenaceous rock, changing from ferruginous or micaceous sandstone to arenaceous limestone, in some instances of an oolitic structure. It decomposes readily, for which reason it is observed in but few localities. Quite worthless for any economical purpose.

V. Magnesian limestone, ten to twelve feet thick, usually heavily bedded, of rather coarse texture, dark buff, and not so pleasing in appearance as that of Joliet; but it is a most excellent building rock, obtainable in any required dimensions. One detached block, solid without fissures, measured twelve by ten feet and six feet high. It breaks in square blocks, requiring but little trimming. Many years ago this rock was quarried, above Larvey's creek, for the Illinois internal improvements, and thousands of tons of the finest dimension rock are now lying, already quarried, along the slopes of the bluff. It retains the sharpest edges and toolmarks, and is in every way the best rock for heavy buildings that I saw in the west.

VI. Brecciated limestone sixteen feet thick. This is a very variable bed, usually consisting of a very pure, fine grained, blue limestone, broken up into small angular masses and cemented together again with fragments of chalcedony and other pebbles. In some places it forms a bed of fine grained limestone upwards of a foot thick, but not very valuable for building purposes. It furnishes, however, a very good material for lime.

VII. Sandstone, heavily and irregularly bedded, fifteen feet thick, varying from a coarse, hard, ferruginous stone to a very fine, friable, and perfectly pure white sand. It overlies the brecciated limestone unconformably; contains stigmaria and charred impressions of other coal plants; is in some places overlaid by fireclay, slates, and coal, and is, therefore, entirely distinct from either the ferruginous sandstone of St. Louis, or the lower sandstone of the Chester beds. I think it clearly belongs to the coal measures. Some portions of this rock would furnish very good building material, but owing to its irregular bedding and varying texture it would hardly pay to quarry it.

In a few isolated places clay-shoals, slates, and coal have been found above the sandstone, but as they furnish no material for building and are of no importance any way, I paid but little attention to them.

H. A. ULFFERS,
Civil Engineer Assistant.

C.

I, Thomas H. Griffiths, secretary of the Northern Line Packet Company, a company owning a large amount of tonnage, consisting of steamboats, barges, and lighters, exclusively engaged in the transportation of freight and passengers from St Louis, Missouri, to St. Paul, Minnesota, and intermediate points between said cities on the Mississippi river, do hereby certify, that at low stages of the water on the upper Mississippi river, and also at what is called medium stages of the water on said river, that the steamboats owned by said Northern Line Packet Company have to lighten the freight that they carry at the lower or Des Moines rapids into lighters used for that purpose exclusively, and also to lighten into freight cars of the Keokuk, Mt Pleasant and Muscatine railroad, from Keokuk to Montrose, on the up stream trips, and from Montrose to Keokuk, on the down stream trips, being a distance of about twelve miles, Keokuk being at the foot of said rapids, and Montrose being immediately at the head, and that the cost of said lightering is considerable; and also that the steamboats with their full crews are necessarily detained there while transporting their freight into lighters and railroad cars, and after passing the rapids in transferring the same back to the steamboats, causing the company thereby a heavy expense.

That the deponent's position of secretary of said Northern Line Packet Company gives him free access to all the accounts of the said steamboats so employed, and it is his duty to examine the accounts of the steamboats so employed, and from examinations of said accounts, and comparing and computing the same, it is the deponent's opinion, to the best of his knowledge and belief, that the said expenses actually incurred, caused by the impediment to navigation at the Des Moines rapids, per trip, for each steamboat, will not average less than one thousand dollars per trip for the entire season of navigation, meaning when not obstructed by ice, counting the extra labor paid, actual expenses paid, for transporting the freight across or around the said rapids, and a reasonable estimate of the expenses of the steamboats while engaged in transferring the freight, and that this estimate is based on the expenses there for the past two years That during the year 1866 the boats owned by the company made their trips, as per list, viz: Steamboat Minnesota, 21 trips; steamboat Muscatine, 20 trips; steamboat Sucker State, 21 trips; steamboat Hawkeye State, 14 trips; steamboat

Davenport, 22 trips; steamboat Burlington, 19 trips; steamboat Pembina, 20 trips; steamboat Canada, 18 trips: steamboat Savannah. 8 trips; steamboat Reserve, 17 trips; steamboat Petrel, 16 trips; steamboat Little Giant. 9 trips; steamboat Bill Henderson, 3 trips; steamboat America, 3 trips; making in all 211 trips, costing on an average of $211,000 for the season of 1866. The company owns and maintains for this exclusive purpose and benefit a steam towboat or tug and seven lighters, for use at the rapids. They also own thirty-seven barges, which are used in transporting freight, as before mentioned, between St. Louis and St. Paul, and intermediate points.

That deponent has served as secretary of the Northern Line Packet Company for seven years, and previous to which he was a practical navigator, as master of a steamboat for twenty-three years, and from his long experience in the freighting business, and acquaintance with this particular trade, is satisfied that the commerce of said river will increase rapidly, and should the rapids be improved, as contemplated, that the amount would be doubled in a year, or in two years, at the furthest, after said improvement is made, owing to the more rapid and certain transportation of freight, and that it would be reduced very largely in cost.

It is difficult so state the exact delay there is to our boats, but in my opinion it will average, during the season, a delay to each boat, each trip, about two days, not having exact data to make the estimate; but this is nearly correct, if not quite so.

I would further state that the Northern Line Packet Company own in steamboats, barges and lighters, engaged in transportation on the upper Mississippi river, in round numbers, about ten thousand tons.

THOMAS H. GRIFFITHS,
Secretary Northern Line Packet Company.

STATE OF MISSOURI, *County of St. Louis:*

On this 8th day of January, A. D. 1867, before me, the undersigned, notary public, came Thomas H. Griffiths, secretary of the Northern Line Packet Company, who states on his oath that the within affidavit subscribed by him in my presence he believes to be true.

[SEAL.] C. HEQUEMBOURG,
Notary Public.

True copy:

J. H. WILSON,
Lieut. Col. 35th Infantry and Brevet Major General U. S. A.

E 2.

Plan for the improvement of the Des Moines rapids of the Mississippi river, by means of a lateral canal along the Iowa shore; unanimously adopted by the Board of Engineers, May 13, 1867.

UNITED STATES ENGINEER'S OFFICE,
Davenport, Iowa, May 13, 1867.

GENERAL: The Board of Engineers convened by Engineer Orders Nos. 18 and 20, March 22 and March 26, 1867, having met at Keokuk, Iowa, on the 15th of April, and adjourned to this place on the 3th of April, beg leave to submit the following conclusions and recommendations in regard to the improvement of Des Moines rapids of the Mississippi river:

1. After a careful examination and consideration of all the plans, profiles and river soundings, and of the calculations and views of the engineer and his assistants, an inspection of the ground on both sides of the river, from a point above

Montrose and Nauvoo to a point opposite the mouth of the Des Moines river and the town of Warsaw, and a study of all the plans proposed, it is the unanimous opinion of this board that the general plan of a canal and locks, submitted to the engineer department by Brevet Major General J. H. Wilson, dated January 1, 1867, and approved by Brevet Major General A. A. Humphreys, Chief of Engineers United States army, in his report of February 5, 1867, to the Secretary of War, is the best for permanently improving the navigation of the Des Moines rapids of the Mississippi river, namely, "a canal along the Iowa shore from a point near the present site of the Keokuk indicator at the city of Keokuk, to a point just below the village of Nashville," seven and six-tenths miles long, with such modifications in detail as are hereinafter specified.

2. That taking the gauge of extreme low water at or near Montrose as a guide, the canal bottom at the upper end of the proposed canal at Nashville and the level of the tops of the mitre-sills at the guard-lock should be fixed at five feet below such low water at the guard-lock, and that the lower mitre-sill of the outlet lock at Keokuk be fixed at five feet below the low water of 1864, at that point, as referred to in the alternate suggested in General Wilson's report. That the canal and the middle and lower locks be arranged for eight feet depth of water when the river rises above extreme low water three feet. That the head of the guard-locks be built two feet above the high water of 1851, as shown in the plan submitted by General Wilson, and that the chamber and lower gate be built high enough to pass boats through the lock when the river at that point may be twelve feet above low water. That the size of the lock chambers shall remain as given in General Wilson's report, namely, 350 feet between the quoins and 80 feet wide at the top. That the thickness of the lock walls, as planned, is abundant for any pressure that can come against them; and it is suggested, that, in the final arrangements of the details, the engineer in charge should be authorized to make such reduction in thickness, for economy, as he may deem safe. That the reverse gates proposed at the outlet lock are unnecessary, and may be economically dispensed with.

3. That the final width of the canal be established at not less than 300 feet throughout, both in excavation and embankment; but in excavation at the time of construction it may be reduced to 250 feet, without material disadvantage. That the top of the embankment be fixed at two feet above the flood of 1851, at ten feet width, with side slopes not less than 1¼ and not more than 1½ base to 1 vertical, as the engineer in charge of the work may determine. That, if it is found economical in the progress of the work, the thickness of the ripraps may be reduced from the thickness suggested in the plan submitted by General Wilson, provided that it be not less than two feet, and that the ripraps, or slope wall on the canal side of the embankment, be raised only to the height of twelve feet above canal bottom, or four feet above the highest water in the canal; and that the residue of the inside slope and the top of the embankment, being above all floods, be sowed with grass, sodded, or covered with a thin coating of stone, as the engineer in charge may determine.

4. In the report of General Wilson, respecting the improvement of the channel above Nashville, provision is made for the excavation of a considerable quantity of rock under water. It is recommended that the engineer in charge be authorized carefully to investigate this part of the stream, with a view of an artificial increase of the depth of the water above the guard-lock, and with a view, also, of dispensing with such portion of said rock excavation under water as may be found practicable—the final arrangement to be determined by him, subject to the approval of the engineer department.

5. If the general plan of the canal, with modifications as herein recommended, should meet the approval of the Secretary of War, it is respectfully suggested that all the details and matters not specifically fixed in this report may be left

to be arranged by the engineer in charge upon survey, reports, &c., approved by the engineer department.

6. Estimate for a canal 300 feet wide in embankment, 250 feet wide in excavation, with two lift-locks and one guard-lock, with embankments ten feet wide on top; locks 350 feet long from quoin to quoin, 80 feet wide on top, between Keokuk and Nashville, seven and six-tenths miles.

Grubbing and clearing	$3,000
Bailing and draining	45,000
125,000 cubic yards rock excavation, at $2	250,000
330,000 cubic yards earth excavation, at 40 cents	132,000
200,000 cubic yards embankment hauled from excavation, at 25 cents	50,000
1,069,000 cubic yards earth embankments, at 50 cents	534,500
40,000 cubic yards puddling, at 25 cents	10,000
120,000 cubic yards ripraps, made from rock excavation, at 75 cents	90,000
150,000 cubic yards ripraps, at $1 50	225,000
	1,339,500
Lower lock	346,407
Middle lock	222,552
Guard-lock	220,464
	2,128,923
Three miles changing line of railroad	24,000
Three miles changing line of public road	3,000
Total for $7\frac{6}{10}$ miles	2,155,923
Add for work between Nashville and Montrose, to make a channel 300 feet wide and 5 feet deep	475,653
Total	2,631,576

The above sum is believed to be ample to cover contingencies and complete a perfect navigation over the whole length of the rapids.

7. That the work necessary to carry into effect the plan herein recommended should be put under contract between Keokuk and Nashville without delay, and pushed vigorously to completion, so that the improvement of the rapids may be made available for commerce and navigation as soon as possible.

8. The important question submitted to the board has occupied their undivided attention for several weeks, during which numerous points of interest have been discussed and many views presented and considered. Some time must elapse before a complete report can be drawn up embodying the views and opinions of the board upon the several plans which have been considered; meanwhile pressing business demands the immediate personal attention of the members of the board at their respective headquarters. Under these circumstances it is the opinion of the board that they will best subserve the public interest by adjourning, to meet again at this place, on the call of the president of the board, for the purpose of adopting the final report of proceedings. During this interval it is understood that General Wilson, the member in charge of the work, will cause to be prepared a map on a small scale for convenient reference, showing the ground, river bed, and such lines as will aid in exhibiting and explaining the plans of improvement which have been investigated, with the location of the canal on the Iowa side, the profiles representing the canal levels and locks, the excavations, and the top of the embankments two feet above high water of 1851;

also showing the line of low water of 1864, and the line of high water of April, 1867—being a copy, on a reduced scale, of the maps, charts, and profiles already prepared by General Wilson, showing the modification indicated in the proceedings of the board.

All of which is respectfully submitted.

J. N. MACOMB,
Colonel Engineers, Brevet Colonel U. S. A.
J. H. WILSON,
Lieutenant Col. 35th Infantry, Brev. Maj Gen'l U. S. A.
G. K. WARREN,
Major Engineers. Brevet Major General U. S. A.
W. MILNOR ROBERTS,
Superintending Engineer Ohio river Imp., Civil Engineer.
PETER C. HAINS,
Captain Engineers, Brev. Lt. Col. U. S. A., Recorder.

Major General A. A. HUMPHREYS,
Chief of Engineers, Washington, D. C.

E 3.

DAVENPORT, IOWA, *July* 20, 1867.

GENERAL: The undersigned, pursuant to your instructions, met at Keokuk, Iowa, on the 16th of April, 1867, for the purpose of submitting a plan of improvement for the Des Moines rapids of the Mississippi river, under the following orders of the engineer department:

[Engineer Orders No. 18.]

ENGINEER DEPARTMENT,
Washington, March 22, 1867.

In accordance with the following provision of the "act making appropriations for the repair, preservation and completion of certain public works, heretofore commenced under the authority of law, and for other purposes," approved March 2, 1867, viz: For improving navigation on the Mississippi river at Des Moines, or lower rapids, according to such plan as the Secretary of War shall, on the report of a board of engineers, approve, five hundred thousand dollars, ($500,000.) and, by authority of the Secretary of War, a board is hereby constituted for the purposes herein specified, as follows:

Brevet Brigadier General T. J. Cram, colonel engineers; Brevet Colonel J. N. Macomb, lieutenant colonel engineers; Brevet Major General J. H. Wilson, lieutenant colonel 35th infantry; Brevet Major General G. K. Warren, major engineers; W. Milnor Roberts, civil engineer Ohio river improvement.

The recorder of the board will be Brevet Lieutenant Colonel P. C. Hains, captain of engineers.

The board will assemble at Keokuk, Iowa, on the first Monday of April, 1867, or as soon thereafter as practicable.

The subject of the improvement of the Mississippi river at the Des Moines rapids is committed to the board without restrictions.

Upon the call of the board Brevet Major General J. H. Wilson, the officer in charge of the surveys and examination of the Des Moines rapids, will lay before it all the information relating thereto that has been collected by him, embracing reports, plans, estimates, maps, &c.

Should further examinations or surveys be necessary in the opinion of the board in order to facilitate the investigations, it is authorized to have them made, provided they are not of an extended character; the necessity for such as are of that nature will be reported here before being executed.

Authority is given to the board to collect all information that in its judgment may be necessary to the proper determination of the questions involved.

The result of the proceedings of the board will be transmitted to this department at as early a day as practicable, in order that it may be submitted to the Secretary of War for his decision

A. A. HUMPHREYS,
Brig. Gen. and Chief Engineer, Maj. Gen. Volunteers.

[Engineer Orders No. 20.]

ENGINEER DEPARTMENT,
Washington, March 26, 1867.

The board of engineers constituted by Engineer Order No. 18, dated March 22, 1867, is modified so far as prescribes the day of assembling.

The day of the meeting of the board is postponed until Monday, April 15, 1867.

A. A. HUMPHREYS,
Brig. Gen. and Chief of Engineers, Maj. Gen. Vols.

[Telegram.]

WASHINGTON, D. C., *April* 17, 1867.

Colonel J. N. MACOMB, *United States Engineers:*

The board will proceed with the business for which it was convened upon the arrival of General Warren, not waiting for General Cram.

A. A. HUMPHREYS,
Chief of Engineers.

On the arrival of General Warren the board immediately organized and entered upon the duties assigned to it. A personal examination of both shores of the river, from Nauvoo to the mouth of the Des Moines river, was made by the board. The board was also supplied with the detailed maps made by General Wilson last fall, which furnish all the information necessary for a thorough investigation of all the plans of improvement that have been proposed, consequently the board did not find it necessary to make any further surveys, and having considered the character of the facilities and accommodations required by commerce, have the honor to submit the following report:

In the order of the engineer department, the "subject of the improvement of the navigation of the Mississippi river at the Des Moines rapids is committed to it without restriction."

The board, in view of the latitude given it by the department, has carefully and thoroughly investigated every plan of improvement that has been proposed, or could be applied, to remove the present difficulties, and every effort has been made to arrive at none other than correct conclusions. The conclusions of the board have already been made known in their preliminary report of the 13th of May.

The considerations that come up on the investigation of the subject, and upon which the board is called upon to make and express its views, will, for convenience, be arranged in the following order:

First. Description of the rapids, comparison of the surveys made at different times, and the relation between the stages of water at different places on the rapids and above and below.

Second. The dimensions that any improvement should have in order to fully accommodate the requirements of navigation; and in case locks are used, their plan, size, and general arrangement.

Third. Plan of improvement of the natural channel of the river by widening and deepening it. Estimate of its probable cost.

Fourth. Plan of improvements by means of dams entirely across the river, with locks for steamboats, and chutes for rafts and flatboats. Estimate of its probable cost.

Fifth. Plan and position of an improvement proposed by Mr. G. Edmunds, jr., of Illinois. Estimate of its probable cost.

Sixth. Plan and position of an improvement by means of an excavated shore channel on the Iowa side from Montrose to Keokuk. Estimate of its probable cost; also, of a similar improvement on the Illinois side, from Nauvoo to Hamilton.

Seventh. Plan and position of a canal improvement on the Iowa side. Estimate of its probable cost.

Eighth. Plan and position of a canal improvement on the Illinois side. Estimate of its probable cost.

Ninth. Comparative advantages and disadvantages of the plan of a canal on the Iowa side with that of an excavated side channel on the Iowa side, and also with the canal on the Illinois side. Comparative cost of each, and the opinion of the board as to which is the preferable plan.

I.—*Description of the rapids, comparison of the surveys made at different times, and the relation between the stages of the water at different places on the rapids, and on the bars above and below.*

The following extracts, descriptive of the rapids, are taken from General Wilson's report:

"The Des Moines or lower rapids are situated near the mouth of the Des Moines river, and extend from Keokuk to Montrose, a distance of about eleven miles. During the low water season they interpose a serious and at times an absolutely impassable barrier to steamboat navigation. The upper Mississippi, from St. Paul to the mouth of the Missouri, has, during the lapse of the more recent geological periods, worn for itself a valley, varying from one to fifteen miles in width and sunk below the general level of the prairies on either side, from one hundred and fifty to three hundred feet. In many places, and for much of the distance, this valley is cut through strata of rock, varying in thickness, hardness, and mineral characteristics. Without discussing the agencies by which this erosion, so disproportionate to the present powers of the river, has been effected, the Des Moines rapids present evidence strongly confirmatory of changes in the character of the river itself.

"General Humphreys, in his report upon the hydraulics of the Mississippi river, suggests that it was formerly a clear-water river like the Niagara, fed by a fresh-water lake or lakes of great extent, occupying a large portion of what is now the prairie land of Illinois and Iowa, and that its transformation from a clear into a muddy stream may have been the result of changes which have taken place in its basin. In support of this theory, he refers to the passage of the river through the northeastern extremity of the Ozark mountains at Grand Tower, below St. Louis, where the water has cut down through beds of rock upwards of three hundred feet thick, and probably drained the lake just mentioned.

"Another instance, developed by the survey and examination of my assistant, Colonel Ulffers, amounting almost to a proof, can be found at the head of the Des Moines rapids. Just below Montrose the rocky bluffs recede at right angles from the river, bearing gradually to the northward, enclosing a considerable extent of country above and to the westward, which was once evidently the bed of an extensive lake, whose outlet was at the rapids and whose surface was about 105 feet above the present low water level.

"This lake basin is an extensive level plain, intersected by a network of sloughs, its lower part subject to annual overflows, and covered with a heavy growth of willow, maple, hickory, haw, and vines. The terraces around it are well developed and of an unvarying height; its upper end, and in part its western side, are limited by beds of loam rising 150 feet above low water at Fort Madison, and forming the entire river bluff at this place. How far this loam deposit extends above and into the interior of Iowa has not been determined, and therefore what may have been the extent of the lake in these directions cannot be asserted.

"As before stated, the outlet of this lake was at the present head of the lower rapids. The water stored up there by their ceaseless action for ages, assisted by ice and other geological agencies, gradually eroded for themselves a channel at least a mile wide, nearly 200 feet below the level of the prairies, and extending through limestone rock to the mouth of the Des Moines river and beyond. This erosive action, though productive of such remarkable results, has not been carried sufficiently far to render the river, through this part of its bed, available and safe at all times for the purposes of navigation. From Fort Madison to Montrose, the river is about 2,500 feet wide, and sufficiently deep; but in the rapids its bed of limestone rock, which by some unknown cause seems to have been hardened to a greater degree than the corresponding stratum above and below the rapids, has resisted the action of the water, while its sides have given way. The result is that this mass of rock remains there, acting exactly as an artificial dam whose upper surface slopes about twenty-two feet in eleven miles, and conforms very nearly to the plane of stratification of the rock through which the channel is cut. The bluffs extend along the banks of the river throughout the length of the rapids, presenting a rock escarpment at the present high-water mark, with a sloping gravel beach to low water, and also another escarpment of rock at 105 feet above the present water level, having, likewise, a sloping beach at its foot. The exposed ledges are formed of different strata in the different localities. At some places they are brecciated limestone, (near Montrose,) in others magnesian limestone, (above Larey's creek,) and in others the coal measure sandstone, (below Price's Creek;) but notwithstanding the varying hardness of the strata, they have all been cut through equally by the river in its progress from the upper beach, just mentioned, down to the one at the present low-water level on the rapids. About sixty feet of these bluffs, however, consist of the geode bed lying between the two beaches and made up mostly of an accumulation of clay and marl, easily washed away. The river, forcing its way through these beds of stubborn material, must, therefore, have gradually receded from the foot of the rapids, like the Niagara is now doing, until it reached its present condition; undoubtedly the process of smoothing its path is still going on, although in an imperceptible degree. The places where the bluffs recede from the bank at the mouth of creeks emptying into the river, there are two terraces beside the present river bottom, respectively twenty-five and seventy-five feet above present low water.

"The level part of the town of Nauvoo, at the head of the rapids opposite Montrose, is built upon a twenty-five foot terrace, which is likewise prominent around the edge of the plain, between the latter place and Fort Madison. The seventy-five foot terrace is most prominently developed near Sandusky.

"The total depth of Des Moines rapids, measure along the Iowa shore, from Montrose (old Fort Des Moines) to the St. Louis Packet Company's landing, at Keokuk, (station D to V,) is 10.92 miles; on the Illinois side, from Nauvoo to the Hamilton ferry landing, (station 23 to 84,) is 12.20 miles, or a mean of 11.56 miles. The bed of these rapids, throughout its entire length, has reached a stratum of cherty limestone, belonging to the Keokuk group of the carboniferous series. The nature of this rock, consisting as it does of thin beds of limestone, interspersed with at least an equal amount of brittle chert or horn stone, precludes the idea that the different 'reefs' or 'heads of chains' might be occasioned as formerly supposed, by a succession of strata, which, in their outcrop, would form a barrier across the river. The deeper parts are all caused by erosion, originating partly from the strength of the current, aided by the presence of numerous granite boulders, and partly by masses of ice which are anually swept down by the spring freshets with tremendous force.

"In the various soundings carried across the river, no trace was found of 'pools' or places where the area of the cross-section would be sensibly greater than on the 'heads of the chains;' in other words, there is no proper chain crossing the river at any point, nor is there anything like a true 'pool,' the deep water being found more properly in pockets and fissures.

"The river bottom is a broad, smooth rock, seamed by a narrow, crooked channel, or in some places several of them, alternatively widening and narrowing, shoaling and deepening, nowhere good navigation, but more difficult in some places than in others. The rapids are therefore not broken and noisy, but, the descent being gradual, the water flows over its bed in a broad, smooth, unbroken sheet, with nothing but the faintest ripples on the surface to indicate the dangerous places. The casual observer would not suspect the presence of the rapids unless he were notified of their locality beforehand.

"From these facts it may readily be inferred that boats would not undertake their passage at night, even if the channel were deep and well defined.

"The worst parts of these rapids are called by steamboat and river men 'chains,' of which there are five principal ones, known as Lower, English, Lamillies, Spanish, and Upper, respectively.

"From the lower to Spanish chain, inclusive, the channel used by steamboats is crooked, shallow, and exceedingly difficult of navigation, requiring, as General Warren states in his report of April 6, 1854, to be excavated almost continuously to the landing at Nashville, a distance of seven and a half miles. For this distance the fall is about 18 feet, and the average slope 2 4 per mile. From Nashville to the upper chain the channel is straight and deep, and the fall only four feet, or not more than a foot per mile.

"The lower chain extends from Keokuk to the mouth of Price's creek. The channel is 3 5 to 8 feet deep, but it is very swift and crooked, and therefore intersected by surface and under currents, particularly on that part of it known as 'Sucker's Chute' and 'Omega Patch.'

"The greater part of the last appropriation was expended here, improving the channel materially, but the fragments of the rock blown out were piled alongside of the channel, injudiciously, it appears, as the ice has already carried away the greater part of the piles and redeposited the fragments of rock in the channel.

"The English chain extends from Montebello to Waggoner's warehouse. The channel, running near the Illinois shore, in this reach is comparatively straight, from 4 to 7 feet deep, and from 50 to 200 feet wide, and presents no particular difficulties to navigation except in times of high wind.

"The head of Lamillies chain is opposite the mouth of Larey's creek. The channel is from 4.5 to 10 feet deep, and an average of 120 feet wide, but it is crooked, intricate, and dangerous, owing to the presence of many shoal patches or rocks; the peaks of which are not distinguishable in rough weather.

"Spanish chain extends from Judge Ballinger's place to within half a mile of Nashville; the channel is from 3 to 13 feet deep, and from 25 to 300 feet wide, and although sufficiently difficult of navigation, has been somewhat improved by excavation.

"The upper chain extends out a short distance below Montrose island, and is made by a broad flat bed of rock extending entirely across the river, upon which the water in dry seasons is not more than 2 feet deep, and frequently not a foot deep. The channel is only a channel in name, having nothing more than a slight depression in the rock, about 3 feet deep and 50 feet wide in the narrowest place.

"The difficulty of navigation, it may be observed, on all the chains lies not so much in the shallowness of the channel or thread of the current as in its unevenness of bottom, insufficient width, tortuous direction, and great velocity. The influence of these features is exaggerated by cross-surface and under currents, and by east and west winds. From fear of the rocks, boats are compelled to move slowly, and therefore more difficult to guide, and no matter how skilful the pilot may be, his boat will be carried forward in the direction of the original impulse for some distance before it can be made to obey the helm. This is particularly the case in windy weather, and while going down stream. The greatest fall on the rapids is on the lower chain, where it amounts to 1.472 feet in 1,000 feet or 7.77 feet per mile. The velocity is consequently greater here than at any other place.

"In 1865 and 1866 navigation opened about the first of March, and closed about the first of December, giving 275 days, which may be considered somewhat above the average for the boating season.

"By an examination kept at the Keokuk indicator by the Upper Mississippi Pilots' Association, it appears that the water on the lower chain was less than four (4) feet for fifty days during 1865, the least depth, 2.3 feet, having been reached on the 20th of June; but this was quite an unusual season, the lowest water generally occurring about the middle of September and continuing much longer.

"During 1866 the same register shows ninety-two days, or one-third the entire season, when the water was less than four feet. The least available depth recorded was two feet, and occurred on the fourth or fifth of October. From the 28th of September to the 2d of December the water ranged between two feet and 3.3 feet on the lower chain. This was about an average year. The dryest season known was that of 1864, when the river, early in September, reached a stage about ten inches lower than that just mentioned. * * *

"During the extreme low-water season navigation for steamboats along the rapids is entirely suspended, and their cargoes are transferred either by rail or lighters, at an extra cost of about one dollar per ton, and an average cost of about five hundred dollars per day to the steamboats themselves while discharging and taking on freight."

The board do not feel called upon to enter into an argument upon the benefits to be derived from an improvement of the navigation at the Des Moines rapids, nor the necessities that demand such improvement; that it is desirable, even necessary, must be patent to all, and Congress has already recognized this fact by making large appropriations for that purpose.

An examination of the printed reports of Lieutenant R. E. Lee of his survey in 1836, of Lieutenant G. K. Warren of his survey in 1853, and of General J. H. Wilson of his survey in 1866, shows some seeming discrepancies in the report of the maximum fall from the head to the foot of the rapids, and in the ranges of the surface between extreme low water and extreme high water at the head and foot of the obstructions.

Thus Lieutenant Lee reports the maximum fall at low water to be 24 feet; Lieutenant Warren reports it to be 21 feet; and General Wilson's survey, "sensibly 22 feet."

The range from low water to high water at the head of the rapids is placed by Lieutenant Warren at 11¾ feet; by General Wilson at 12.65 feet. The same quantities at the foot of the rapids are given by Lieutenant Warren at 21 feet; by General Wilson at 19.28 feet.

Some of this discrepancy may be explained by the low water of 1864, which is reported as the lowest known, and assumed by General Wilson as the low-water plane. This would increase Lieutenant Warren's range at the head of the rapids, and his total of the fall from head to foot nearly to that reported by General Wilson; but it should also increase his range of surface at foot of the rapids, previously exceeding General Wilson's by 1⅝ foot. It should also apparently increase the slope determined by Lieutenant Lee, which before gave a fall two feet greater than that determined by General Wilson.

The *second* most obvious source of disagreement is the uncertainty of ascertaining the extreme high and low-water marks, because of their rare occurrence, the long interval of years between the three surveys, and the different conditions under which the high and low-water stages of a river result, which different conditions nowhere make themselves more felt than at the head and foot of a rapids or dam.

To these varying conditions the Des Moines rapids are peculiarly subjected, though their considerable length in comparison with the maximum fall makes the effect much less apparent than at the falls of the Ohio at Louisville. Then, too, the broad and low bottom lands of the Mississippi above and below the rapids tend to diminish the effect of local freshets, for, serving as a reservoir for the waters, they diminish the rise of floods, and the time required for their drainage prolongs the medium and shortens the lowest stages.

Flowing, as the Mississippi does, from north to south, its spring, summer, and autumn floods follow, in its different latitudes, the changes of the season, so that a rise on the rapids may come from its extreme sources, or from the regions intermediate, or from the local streams.

And it happens that the principal of these latter, the Des Moines river, enters the Mississippi below the rapids themselves. We have thus produced the variations known as head rises and back-water rises, and, of course, all the combinations which they can produce by uniting in their various magnitudes.

We have, besides, the effect of wind, which, blowing up the stream at low water, diminishes the flow at the head of the rapids, while it banks up at the foot, diminishing the fall in a two-fold degree, and, when blowing in the opposite direction, causing a rise on the upper chain and a fall on the lower chain.

These sources of fluctuation would seem ample to account for all the discrepancies noted. Indeed, these discrepancies do not, it may be feared, indicate the extent of the liability to err from conclusions based on a single season's work.

As the data derived from these three surveys are of the greatest importance in determining the question of improvement, it is evident that a most exhaustive treatment of the information possessed is required.

Before proceeding with this, however, a *third* source of discrepancy, if existing, must be eliminated, namely, errors in the levelling itself.

COMPARISON OF LEVELS.

Lieutenant R. E. Lee says of his survey:

"A line of levels was run on the Wisconsin (now Iowa) side, and the meanders of each shore determined by a compass. * * * *

"The distance from the head to the foot of the rapids is 11.005 miles, and the entire fall at the time of making the survey (autumn of 1836) was 24.015 feet. * * * * * * * * *

"The height of the river could only be compared with extreme low water, by the relative quantity on the shoalest parts, and which was ten or twelve inches more than is said can be found at its lowest stages."

This is all the information of this levelling at present available, and there is no connection with his bench-marks.

The level notes taken by Lieutenant Warren were on the right bank, the same bank as Lieutenant Lee's. They were made on November 15 and 16, 1853, the water showing no change during the time, and being at its lowest stage for that year.

Lieutenant Warren was led to conclude it was within six inches of the lowest stage. The level notes were taken by himself personally and with care, but admits that there being but a single line run, errors may possibly have been committed. The only one of his bench-marks on the right bank now recognizable is that of "the door-sill of Chittenden's (now Iowa Hotel) hall door," in Keokuk, which is on his datum line 41.896. There is also a bench-mark for the grade of the streets of Keokuk, and on the plans of that city has a reference 21.74, being that number of feet above the surface of the water when the levels for establishing the grades were run by Mr. Guy Wells in 1849.

General Wilson's survey comprised lines of levels on both banks of the Mississippi, which gave, according to his report, a difference of fall from head to foot, differing only .113 of a foot, and may be regarded as in perfect accordance.

Owing to shortness of the season a direct transfer of the levels across the stream by the instruments was not effected, a matter of difficulty with so wide a river intervening.

The recorded observations made by the pilots on their gauges at the head and foot of the rapids, furnish, however, a tolerably good means of transferring these levels, by assuming the water of the river to be level across the stream at opposite points of the pool above the rapids, and again below them.

At Montrose, October 16, 1866, right-bank levels gave the water a reference 34.658.

At Nauvoo, October 18, 1866, left-bank levels gave the water a reference 36.436; the Montrose gauge during the time being at a stand, and reading one foot, shows that the two datum lines were 1,778 feet apart, and that the zero of the Montrose gauge was at a reference to right-bank levels 33.658.

Below Keokuk, November 12, 1866, the right-bank levels gave the water a reference 11.767, and below Keokuk, November 12, 1866, the left bank levels gave the water a reference 13.993; thus showing a difference here, in the two datum lines, of 2.226 feet, and differing only 2.226 — 1.778 = .458 foot from what it was at the head, which is as close agreement as the method of comparison could exact. General Wilson's levels, therefore, contain all the test for accuracy that can be applied. In any comparison of his level notes with others, his datum line on the right bank will be the common one to which all will be reduced, and two feet will be subtracted from his left-bank references to bring them to this reference.

The level of the door-sill of Chittenden's hall door, on General Wilson's survey, is 36.734; on Lieutenant Warren's (as before stated) 41.896; hence 5.162 feet subtracted from Lieutenant Warren's reference reduced them to General Wilson's.

The comparison of the total fall on the rapids shows a close agreement in amount between Lieutenant Warren and General Wilson, but Lieutenant Warren's low-water plane of 1853 is, both at the head and foot of the rapids, nearly two feet lower on the common datum line than General Wilson's of 1866.

Other differences exist which can only be satisfactorily accounted for by a different level of the water itself, or a difference in the recorded remarks of high water and low water, or by errors in levelling.

The first discrepancy is in the high-water mark of 1851. Lieutenant Warren's was obtained from the Phœnix Hotel in 1853; General Wilson's from Brown's warehouse in 1866. The first is using the common reference 30.881, and the second 30.001, a difference of $\frac{723}{100}$ feet.

The Phœnix hotel is now gone, but the two locations were nearly the same so that the difference can only be accounted for by an error in the marking of one place or the other.

This was a most remarkable high water, especially at the foot of the rapids.

Waggoner, an old pilot living midway of the rapids, says "the highest ever known," exceeding, at his place, that of 1828 by two feet. This, he says, was due to the back water of the Des Moines river, (at the time in excessive flood,) for at Montrose the water only reached the height it did in 1828.

Again, Lieutenant Warren's low water of 1853, where it crossed the lowest reef of the rapids, has nearly the same reference as General Wilson's for 1866. But in the succeeding 2.300 feet below, Lieutenant Warren found the river surface to fall (November 15, 1853) 4 5-10ths feet, while on November 12, 1866, General Wilson's survey found a fall of only 2 45-100ths feet.

The slope of Lieutenant Warren's low water passes through the reading (1) one foot on the Keokuk pilots' gauge, so that the low water of 1864, which is the zero of this gauge, should have, opposite Brown's warehouse, a reference 9.160, which taken from Lieutenant Warren's reference for high water of 1851, viz., 30 881, makes the extreme range at foot of rapids to be 21.721 feet.

Lieutenant Warren's survey makes the fall of the river on the lower chain, in 1853, to be 8.34 feet.

General Wilson's survey, November 12, 1866, makes it only 6 78-100ths feet.

Lieutenant Lee's tables, in his printed reports, makes his fall only 5.8 feet, which is the more noticeable, as he makes the total fall on the rapids greater than either of the others. An examination and comparison of his table shows that it will not accord with General Wilson's or Lieutenant Warren's levels below Nashville, making the fall much greater than they do on Lamillies and English chains, but less than on the Lower chain.

It would therefore seem safe, in view of all the facts, to adopt, as the highest known water at the foot of the rapids, Lieutenant Warren's for 1851, and the lowest as the low water of 1864, having the respective reference of 30.881 and 9.160; the small space over which Lieutenant Warren's levels extended in making these references to the bench-mark now existing, rendering it improbable that he committed any material error.

Proceeding now in our examination to the head of the rapids, more unaccountable differences are found to exist between Lieutenant Warren's and General Wilson's levels. The former found, at the time he was opposite Mechanic's Rock, (November 15, 1853,) that it was 2 feet out of water.

Captain Holliday says "that in the low water of 1864, it was out 40 inches;" hence it must have been 16 inches lower in 1864 than 1853.

This agrees mainly with the result deduced before at the foot of the rapids. But the zero of the Montrose pilots' gauge was placed at the level of the low water of 1864, which zero, referred to General Wilson's survey, has the reference 33.95; and Lieutenant Warren's low water, November 15, 1853, at Montrose has, on the same datum, a reference 32.7; whereas it should have had (in order to be a foot above low water of 1864) a reference 34.95.

The conclusion from this is that there is an error of 2¼ feet in the levels between the head and foot of the rapids. Either Lieutenant Warren makes the fall at low water 2¼ feet too little, or General Wilson's survey makes it 2¼ feet too great.

The test already applied to General Wilson's double line of levels, places the grounds for confidence in their favor. On this conclusion we have the reference of low water of 1864 at Montrose, as given by General Wilson's survey, 33.95. Taking now the lowest water reference at Keokuk, viz., 9.160, we have for the maximum fall or lockage to be overcome 23.790 feet, which differs from Lieutenant Lee's total fall by being ¼ foot less.

Lieutenant Warren's high water of 1851, at Montrose, referred to General Wilson's datum, has a reference 46 25; and as low water of 1864 has reference 33.95, we have maximum range at Montrose 12.30 feet.

The difference of high water of 1851 at Montrose and Keokuk is 46.250—30.881=15.369 feet.

Lieutenant Lee's survey makes the low water fall from Montrose to Nashville 3.65 feet.

Lieutenant Warren's survey makes the low water fall from Montrose to Nashville 3.3 feet.

General Wilson's survey makes the low water fall from Montrose to Nashville 4.00 feet. The mean of all is 3.65 feet.

In any plan of improvement the result most unfavorable to it should be taken.

General Wilson's high water of 1851, at Waggoner's, has a reference 34.000. This place is about 37,500 feet from head of rapids, and 22,500 feet from the foot of the rapids. High water at head is 46.25; at foot, 30.881. High water fall from head of the rapids at Waggoner's, 12.25; from Waggoner's to foot of the rapids, 3.129; making very apparent the effect of back water, which Waggoner has stated.

Before considering the effect of a rise on different parts of the rapids, and of the different kinds of a rise; a description will be given of the so-called indicators, established at the head and foot of the rapids by the Pilots' association.

These consist of excellently constructed wells on the river bank, extending down below the lowest probable water levels at the head and foot of the rapids, and communicating freely with the river. A copper drum is made which floats in this well, and supports a graduated rod, which slides as the water rises and falls through guides on a frame which keeps the rod vertical. The first graduation is in feet and inches, and gauges simply the rise and fall of the river at the place. The others were designed to show the corresponding number of feet of rise on the different chains, and at the other end of the rapids. Over these wells and gauges neat houses were built which protect the indicators from injury and observation from without.

At the Keokuk indicator a book is kept in which each pilot records the reading of the gauge at Montrose and Keokuk, at the time he passed the rapids, as also the draught of his vessel, wind, ice, &c. The zero of each gauge was placed at the level of the low water of 1864, and the record has been kept since the opening of the river in 1865.

As gauge records, they answer admirably, and are the most excellent ones on the Mississippi; but as indicators of the stages on the rapids intermediate, the graduated scale must, in the nature of the case, be very unreliable, especially the one at the foot of the rapids, owing to the influence of back water from the Des Moines river, and also from high south winds in the low stages.

Being politely furnished with the record book kept at the Keokuk indicator for examination, the observations have been plotted so that one co-ordinate shall be the stand of the gauge at Montrose, and the other the corresponding fall from head to foot of the rapids.

The two zeros being the low water of 1864, have, according to General Wilson's levels, a distance apart vertically of 23¾ feet, (which is the low water fall.) The curve then begins with the co-ordinates, zero, and 24¾ at low water; at high water of 1851 they would be as hereinbefore deduced, gauge reading 12.3 and fall 15.369. These two points include the highest and lowest points of the curve.

The highest observation recorded by the pilots was eight feet at Montrose; this gave a fall 19 4 feet on rapids; the next highest, 7½ feet; this gave in one instance a fall of 17 feet, and another of 19 4 feet, thus showing a difference of fall 2$\frac{4}{10}$ feet, not due to the amount of water passing at Montrose. For it must be considered that the stand of the Montrose gauge is mainly dependent upon the quantity of water passing, and is not, like the Keokuk one, affected materially by back water.

At a stand of six feet the observations show variations in fall from 18.5 feet to 20½ feet.

At a stand of five feet the observations show variations in fall from 19.5 feet to 21.7 feet.

At a stand of four feet the observations show variations in fall from 20 to 22 feet.

At a stand of three feet the observations show variations in fall from 21.6 feet to 22.4 feet.

At a stand of two feet the observations show variations in fall from 21.3 feet to 22.5 feet.

At a stand of one foot the observations show variations in fall from 22.3 feet to 23.2 feet.

At a stand of six inches the observations show variations in fall from 22.5 feet to 23.5 feet.

In one instance in June, 1865, when the Montrose gauge stood at 1.9, the fall was only 19.6 feet on the rapids. If there was no error in the observation, this would indicate a back-water rise from the Des Moines at the low stage of about three and a half feet on the Lower chain.

The effect of wind up or down the stream probably makes the majority of the fluctuations in the total fall, and appears to amount to about a foot in medium stages. The observations are not complete enough to decide exactly what amount is due to the wind.

The above includes all the practical information to be derived from the before-mentioned plot, and it is not thought necessary to introduce it here.

The best observations we have on the relative rise at different parts of the rapids are those made by General Wilson during the rise in March and April, 1867.

These were taken at the respective readings on the Montrose gauge 2.3, 5.5, 7, and 7.5, and they show that the influence of back water is sensibly felt as far up as Waggoner's, the foot of Lamillies chain, and above that the water does not back, for it so happened that these observations were made during a heavy rise in the Des Moines river.

The plane of high-water in 1851 shows back water up to Waggoner's, but above there soon becomes parallel with the observed plane of April 23, the highest water of the spring of 1867.

We are therefore somewhat authorized to conclude that a rise at Montrose will always produce an equal rise as low down as the foot of Lamillies chain, and that below that point nearly all the fluctuations of back-water and wind are confined. The reading of the Montrose gauge can then be taken for the stage of the river for at least the upper half of the rapids.

VOLUME OF THE MISSISSIPPI.

Observations made at Keokuk for discharge on the 27th of April, 1867, when the river stood on the gauge 13.35, gave the volume at 195,000 cubic feet per second.

The highest water was April 24, gauge reading 15.3. Assuming the velocity not to be greatly different, as it was much affected by back-water from the Des Moines river, we have the high-water discharge of April 24, 1867, 215,000 cubic feet per second; applying the same reasoning to the high water of 1851, (which, however, is very uncertain as the railroad embankment on the Illinois side opposite Keokuk was not built at that time, though the back-water of the Des Moines acted much in the same way,) we would have the maximum high-water discharge of the Mississippi at 265,000 cubic feet per second.

The lowest water discharge is approximated to in the following manner:

Measurements made by General Warren, October 23, 1866, at Burlington, gave a discharge of 36,100 cubic feet per second. This was an average low-water year. The gauge at Montrose, October 23, stood at one (1) foot, and making this deduction at Burlington, and supposing the mean velocity to not change, we should get the extreme low-water discharge of 1864 at 31,913 cubic feet per second. This is probably in excess, but it would be safe to take it at 30,000 cubic feet per second.

General Wilson in his report says the average area of cross section is 17,550 feet at ordinary low water; mean surface velocity is 2.88 feet per second; and its mean velocity deduced therefrom is 2.304 feet. From these data the discharge has been calculated, and is found to be 40,435 cubic feet per second.

Measurements made of the discharge of the Des Moines river, April 29, 1867, ascertained it to be about 35,000 cubic feet per second. The Des Moines was then 2½ feet below high water of April 24, 1867, on which day the discharge was not less than 42,000 cubic feet per second. The high-water discharge of 1851 in the Des Moines could not have been less than 55,000 cubic feet per second, its height then being 7½ feet above the level on April 24, 1867.

At the time of our observations on the Mississippi, April 27, 1867, a rise of one foot corresponded to an increased discharge 10,000 cubic feet per second; consequently the volume of the Des Moines at its floods would be able to secure the Mississippi perhaps five feet above what it would be without it.

An examination of the maps will show that no great rise can occur in the Des Moines valley without a corresponding one in the Mississippi. The Des Moines runs through the whole length of Iowa, and its valley embraces about 12,600 square miles. The area of the valleys of the other tributaries of the Mississippi in the same latitude amounts to about 40,000 square miles, and the country above would probably contribute as much more water contemporaneous with it, so that the Des Moines can never form more than one-sixth part of any considerable flood in the Mississippi.

SEDIMENT.

There is a decided rise in the river produced by the spring floods in the streams in the latitude of the Des Moines, and the water is much more filled with sediment at the rapids at such times than it is at any other. Such fact was very observable to us while at Keokuk, about the 20th of April, but before we were prepared to measure the amount the rise came from the rivers further north and restored it to its usual purity. Out of two quarts of water taken from the Mississippi on the 25th of April careful filtering and weighing obtained but 3½ grains of sediment, or about $\frac{1}{10000}$ of the weight. This is the character of the river during very much of the season, so that there would be but little deposition of mud from it in a canal.

The greatest amount of filling up which a stream produces is well known to arise from the material swept along near the bottom, and the amount of it is very difficult to measure. But the observed fact that the upper Mississippi throws out no material amount of sand on its present bottom lands, which are submerged at high water six to twelve feet, and which rise about ten feet above the low water, gives assurance that walls or banks of canals would not be much affected by the material drifted along the bottom, if carried up as high as the average of the bottom-land banks when submerged at high stages.

The following table exhibits the number of days at which the water stood above the different-numbered feet on the gauges at Montrose and Keokuk, by actual observation. The zeroes of these gauges are at the low water of 1864, at which time there was about one foot of water on the rapids. The rise given on the Montrose gauge extends quite uniformly down the rapids as far as the foot of the Lamillies chain; below this it often and generally rises faster, owing to the back-water and such influences, the greatest amount of which is measured at the Keokuk gauge:

	Above 15 feet.	Above 14 feet.	Above 13 feet.	Above 12 feet.	Above 11 feet.	Above 10 feet.	Above 9 feet.	Above 8 feet.	Above 7 feet.	Above 6 feet.	Above 5 feet.	Above 4 feet.	Above 3 feet.	Above 2 feet.	Above 1 foot.	Below 0 and 1 foot.
1. MONTROSE GAUGE.																
Number of days March 5 to December 8, 1865	....	....	....	....	....	0	0	0	3	16	43	80	146	186	274	0
Number of days March 16 to December 3, 1866	....	....	....	....	....	2	6	9	14	23	43	56	78	197	257	6
Number of days April 1 to April 27, 1867	....	....	....	....	....	....	....	....	8	12	16	21	26	28	28	....
2. KEOKUK GAUGE.																
Number of days March 5 to December 3, 1865	....	....	....	....	12	19	42	64	88	114	190	228	272	274	274	0
Number of days March 16 to December 3, 1866	....	3	10	14	20	28	42	46	54	74	98	151	196	243	253	0
Number of days April 1 to April 28, 1867	1	5	13	15	16	18	20	25	27	37	45	59	59	59	59	0

The following table, from observations kept at the Rock Island bridge, gives the duration of different stages there. The zero is the low water of 1864:

	Above 15 feet.	Above 14 feet.	Above 13 feet.	Above 12 feet.	Above 11 feet.	Above 10 feet.	Above 9 feet.	Above 8 feet.	Above 7 feet.	Above 6 feet.	Above 5 feet.	Above 4 feet.	Above 3 feet.	Above 2 feet.	Above 1 foot.	Zero.
1860	....	....	....	....	7	18	32	47	60	112	135	197	262	300	364	....
1861	....	7	13	21	44	63	78	102	149	166	182	233	303	347	265	....
1862	8	13	18	24	37	58	92	126	159	175	210	233	287	343	360	....
1863	....	....	....	....	....	....	....	13	39	59	85	127	188	214	322	....
1864*	....	....	....	....	....	....	....	2	4	4	35	77	167	181	207	....
1865	....	....	....	....	1	23	31	44	56	85	126	221	315	361	365	....
1866	6	9	17	26	32	40	50	62	79	91	119	164	275	348	365	....
1867	....	....	....	6	24	36	60	87	124	131	May	11, 1867.				

* From July 1 to July 30 no observation.

The maximum range of the Mississippi at Davenport, according to Lieutenant Warren's report of his survey in 1853, is 23 feet, and at the head of these rapids 13 feet. During the time the Rock Island bridge gauge has been kept, the highest water observed was May, 1862, viz., fifteen feet two inches, which would thus appear to have been at this point seven feet ten inches below the range of highest floods, such as that of 1851.

It is difficult to deduce from these observations at the head and foot of the rapids the corresponding rise of the river at the places between the rapids, or above and below them. That it is somewhat more rapid at the foot is apparent from the levelling made by General Warren's parties in October, 1866, at Clinton and at Burlington. These show the extreme ranges at Clinton from lowest to highest water is about 18 86 feet, at Burlington 18.75 feet, and at Quincy 20.31 feet.

The following statement is taken from Lieutenant Warren's report as to the relative effect of rises on the rapids and on the bars above and below, and is the best that can now be given. Supposing that the natural channel was deepened so as to give a low-water depth of four feet, we would then have—

With 3 feet on the bars, 4 feet over the rapids.

With 4 feet on the bars, 4 feet 3 inches over the rapids.

With 5 feet on the bars, 4 feet 7 inches over the rapids.
With 6 feet on the bars, 5 feet over the rapids.
With 7 feet on the bars, 5 feet 8 inches over the rapids.
With 8 feet on the bars, 6 feet 6 inches over the rapids.

From this it is evident it would be required to increase the improved navigation to a low-water depth over the rapids of at least five feet, in order to accommodate the passage of boats, when six feet navigation would be afforded.

II.

Before proceeding to the discussion of the different plans of improvement, the board will state their opinions in reference to the dimensions that any improvement should have, in order to fully accommodate the requirements of navigation.

First. If it be an improvement without locks.

The least width at any place should not be less than 300 feet. The depth should not be less than five feet in extreme low water, in order that boats may pass over the rapids with six feet, when they can carry six feet over the bars. The ordinary low water is about five feet on the bars.

It will be seen by referring to the table taken from Lieutenant Warren's report, which was prepared with great care, that when there is five feet on the bars, (supposing the rapids improve to four feet in extreme low water,) there would be only four feet seven inches on the rapids; and hence a boat drawing the maximum draught up as far as the foot of the rapids would still be unable to pass over them. The ordinary low water, that is, the average depth from about the 1st of July till the 1st of December, will give about five feet on the bars, and boats will invariably load to that depth, if they can get freight and pass over the bars in safety, even though they rub along the bottom; but they cannot be allowed to rub over the rocky bottom of the rapids—they ought to have at least six inches to spare. This would require five feet six inches on the rapids when there are five feet on the bars, and the improvement will then give five feet depth on the rapids in extreme low water.

This the board regard as the least depth that can be given, and make an improvement that will adequately accommodate the requirements of commerce.

Second. If it be an improvement involving the use of locks.

The same depth, viz., five feet in extreme low water, must be had on the mitre-sills of the locks, and the width of the water-way should not be less than 250 feet in excavation, and 300 feet in all other cases, when it could be had without a great increase in the cost of the work.

If it be a canal improvement, taking the pilots' gauge at Montrose as a guide for extreme low water at that place, the canal bottom at the upper end, and the level of the top of the mitre-sills of the guard-lock, should be fixed at five feet below extreme low water. The lower mitre-sill of the lower or outlet lock should be fixed at the same distance—five feet below extreme low water (viz., that of 1864) at that place. The lockage to be effected by means of two lift locks, using the guard-lock as a lift lock, after the water at the head of the rapids rises four feet above the extreme low water.

Third. Width of the lock chambers should be eighty feet, in order that the largest boats navigating the Mississippi or its tributaries may pass through it.

According to the information in the possession of the board, this width of lock chamber will pass any steamer on the Mississippi, with probably only one or two exceptions, and will allow an increase in beam of the majority of steamers that now navigate the upper Mississippi.

It is believed that the time is not far distant when eighty feet width of lock chamber will be as little as will lock through ordinary steamers on the upper Mississippi, though it may now seem large. Eighty feet is the width of lock chamber adopted for the canal around the falls of the Ohio; less than that should not be adopted here.

Fourth. Each lock should have two pairs of gates.

Fifth. Length of lock should be 350 feet between the quoins.

Sixth. The locks should be filled by means of valve or slide gates in the main gates, and culverts and openings passing at right angles through one of its side walls—the number and size of the culverts to be sufficient to fill the lock in as short a time as possible consistent with the safety of the masonry and boats. The locks to be emptied in like manner through culverts in the opposite side wall, and valve gates in the lower gates. The details of construction and mode of operation should be left to be determined by the engineer in charge of the work.

Seventh. That the middle and lower locks should be built high enough to maintain eight feet depth of water in the levels, so that boats of a maximum draught of seven feet may pass over the mitre-sills with one foot to spare. The guard-lock should be built high enough to lock boats through when the gauge at Montrose shall indicate twelve feet above the low water of 1864.

Eighth. The bottom of the canal should slope about one and one-half inch to the mile, when rock excavation on the bottom occurs, in order that a more rapid current may be given to the water at those places, should it be necessary to wash out sediment.

Ninth. The width of the canal embankment should be not less than ten feet on top, including the riprap covering, the slopes of the embankment should be made with one and a half base to one vertical on both sides, and the average thickness of the riprap covering, on the river side, need not exceed two and a half feet, and on the canal side two feet, and on top one and a half feet.

The general range of the top of the embankment should be made not less than two feet above the range of extreme high water. In excavating, however, a large amount of rock will be at the disposal of the engineer, and can be advantageously used in increasing the thickness of the riprap covering of the embankment if deemed necessary. The guard-lock walls to be two feet above the extreme high water, the other lock walls to be high enough to maintain eight feet depth in the levels.

In case any other than a canal plan should be adopted requiring locks to overcome the fall, they should have the same general dimensions and the same general arrangement of their several parts, so far as may be applicable to the case.

III.—*Plans of improvement discussed—Plan of improving the natural channel of the river by excavating the rock.*

This plan was first recommended by Lieutenant Lee of the engineers in 1837, and some work was accomplished during the next two succeeding years under his direction.

The plan was further partially carried out under the direction of J. G. Floyd, United States agent, some twenty years later. About $350,000 have been spent, and as nearly as can be ascertained about 25,000 cubic yards of rock excavated.

It is conceded by pilots, notwithstanding the many assertions to the contrary that the navigation on Lamillies and Lower chains has been somewhat benefited, but in no degree commensurate with the amount of money expended, when the price of labor and materials at that time is taken into consideration.

General Wilson, in his report, speaking of this plan of improvement, says:

"The plan of excavating the channel is for a variety of reasons exceedingly difficult to execute at these rapids, either by blasting under water or by the use of coffer dams. In order to enlarge the channel to 200 feet wide and four feet depth in extreme low water, (low water of 1864,) * * * according to data recently obtained, it will require the excavation of 176,519 cubic yards of rock, which, at an average of $15 per yard, will cost $2,662,797.

"Should this channel be completed it will not accomplish all that is required, for, in addition to the dangers consequent upon cross-currents, it is only indicated by the faintest ripple marks of the running water, and could not, therefore, be used either at night or in fogs, or during unfavorable winds, and a special pilot would be required at nearly all times. Hence, over half the time of extreme low water, the river would still be impassable at the rapids. Other difficulties would also continue to exist. The fall of eighteen feet in seven and a half miles with an increased current would have to be overcome at a great expense in money and time by ascending boats, and the navigation for descending boats would not be shorn of its dangers. In addition to this the water is nowhere deep, and, as the excavation has to be carried lower than is actually required, the tendency is to draw the water from the shores and above and to proportionably transfer the shallow places."

The board concur with General Wilson in the opinion expressed by him that the channel improved to 200 feet in width and four feet depth in extreme low water is not an adequate improvement, and that it would not fully accommodate the requirements of commerce, even supposing there was no difficulty experienced from its crookedness and narrowness, no dangers to be encountered, and no difficulties in navigating the channel at night, and in windy or foggy weather.

It will be seen by referring to the table of stages on the rapids and on the bars prepared by Lieutenant Warren, that with the rapids improved to four feet depth in low water it will only give five feet on the rapids when there is six feet on the bars above and below. This would necessitate the loading of boats a foot lighter to pass the rapids than would be requisite on the bars, or would necessitate a transfer of the freight by lighters or otherwise. Boats frequently load to six feet or more when the stage of the water will allow it, and from this improvement such boats would derive little benefit.

From this it will be seen that a channel improvement ought not to be less than five feet deep in low water, for though it might materially ameliorate the present condition of the rapids to make a channel four feet deep, it would be only a partial remedy of the difficulties. Again, a crooked channel 200 feet wide, exposed in very many places to cross-currents, with a velocity of from three to six miles per hour, is inadequate to afford the facilities that the growing commerce of this great river demands. Many of the same difficulties that are now experienced would still be encountered.

The board is of opinion that a channel at these rapids less than 300 feet wide and five feet deep in low water, following the natural channel, would fail to be such an improvement as is required.

The following estimates, based on the surveys made last fall by General Wilson, will show the amounts of rock excavation and estimated cost of making this sort of channel improvement:

A channel 200 feet wide and four feet deep in extreme low water, is estimated to require the excavation of 176,519 cubic yards of rock.

The board have estimated for a channel 200 feet wide and five feet deep, 318,562 cubic yards; a channel 300 feet wide and four feet deep, 291,869 cubic yards; a channel 300 feet wide and five feet deep, 503,435 cubic yards.

General Wilson estimates that this work will cost $15 per yard, and this is probably a fair price at the present price of materials and labor.

Supposing that in the case of the channel 300 feet wide by five feet deep, on account of the increased amount, it can be done for $10 per yard, and in the other two cases at $11 and $12 50 per yard respectively—we will then have for the estimated cost of the channel improvements as follows:

200 feet wide by 4 deep, at $15 per yard	$2,647,785
300 feet wide by 4 deep, at $12 50 per yard	3,648,362
200 feet wide by 5 deep, at $11 per yard	3,504,182
3000 feet wide by 5 deep, at $10 per yard	5,034,350

IV.—*Plan of dams entirely across the river, with locks for steamboats and chutes for rafts and flat boats, creating a slack-water navigation in the river.*

As this plan has been advocated by several engineers, and as there are no insuperable difficulties in executing it, the board will describe what they conceive to be the best location for such a plan of improvement at the Des Moines rapids.

It will require at least three dams to overcome the fall from the head to the foot of the rapids.

In the lowest stages there is a fall of about 22 feet on the rapids. In extreme low water, the first dam must raise the water on the upper chain 4.2 feet; 0.8 feet being the shoalest depth in the channel on that chain, this will increase the fall from the head to the foot of the rapids to 26.2 feet, which should be divided into three lifts of 8.73 each. The upper dam might be built across the river near station "A" of General Wilson's survey, the second near station "O," and the third or lower dam near the site of the "Keokuk Packet Landing."

The locks should all be on the Iowa side.

The first dam would be 12.9 feet higher than the surface of extreme low water at that place; the middle dam 11.5 feet above low water at that place; and the lower dam 8.7 feet above low water at the Keokuk indicator; or, what is the same thing, the middle and lower dam should each be high enough to raise the water at the foot of the one preceding it to such a height that boats reaching the rapids from above or below could always find plenty of water to pass through the chutes or locks.

For the purpose of estimating the cost of this plan, the dams are assumed to be built of heavy crib ten feet from centre to centre, filled with stone, the upper slopes with 2½ feet base to one foot perpendicular, the lower slope 4¾ to one.

The timbers of the crib should be about one foot square, notched two inches and bolted; the upper slope should be covered with two courses of plank, two and four inches thick respectively; the lower slope with timbers one foot square.

Each dam should be provided with at least one chute, at the most favorable place for navigation. At this place the dam, instead of being built up to the full height, should be finished off at the height of the upper end of the chute for a width of 320 feet.

At a distance of 150 feet on each side of the axis of the chute a crib should be built, high enough to be beyond overflow in the highest stages of the river, ten feet thick, covered with timbers, planked on the channel face; each chute should be at least 150 feet in length—a greater length preferable.

A section of a dam and chute that might be applied in carrying out this plan of improvement at the Des Moines rapids is shown on the accompanying maps. The locks should agree, both as regards the dimensions and general arrangement, with those already prescribed.

The following is an estimate of the probable cost of such a plan of improvement:

UPPER DAM, SIXTEEN FEET HIGH AND 4,500 FEET LONG.

681,667 lineal feet twelve-inch timber, at forty cents	$272, 666 80
855,450 feet, board measure, oak and pine covering and sheet piling, at $45 per thousand	38, 495 25
80,497 cubic yards stone filling, at $1 50	120, 745 50
31,364 cubic yards gravelling, at fifty cents	15, 682 00
411,280 pounds bolts and spikes, at fifteen cents	61, 692 00
Two abutments, 1,480 cubic yards masonry, at $10 per yard	14, 800 00
One chute	22, 000 00

5,000 cubic yards excavation, at $1 per cubic yard	$5, 000	00
8,000 cubic yards embankment, at thirty cents per cubic yard	2, 400	00
	553, 481	55
Add ten per cent. for contingencies	55, 348	15
Total estimated cost of upper dam and one chute	608, 829	70

MIDDLE DAM, 14½ FEET HIGH, 4,800 FEET LONG.

652,800 lineal feet twelve-inch square timber for cribs, notched and bolted, at forty cents	$261, 120	00
993,600 feet, board measure, oak and pine covering and sheet piling. at $45 per thousand	44, 712	00
81,600 cubic yards stone filling, at $1 50	122, 400	00
28,800 cubic yards gravelling, at fifty cents	14, 400	00
393,600 pounds bolts and spikes, &c, at fifteen cents	59, 040	00
Two abutments, 1,400 cubic yards masonry, at $10	14, 000	00
5,200 cubic yards excavation, at $1	5, 200	00
8,500 cubic yards embankment, at thirty cents	2, 550	00
One chute	22, 000	00
	545, 422	00
Add ten per cent. for contingencies	54, 542	20
Total estimated cost of middle dam and chute	599, 964	20

LOWER DAM, 13½ FEET HIGH, 4,200 FEET LONG, AND EMBANKMENT.

504,000 lineal feet twelve-inch timber, square, for cribs, notched and bolted, at forty cents	$201, 600	00
798,000 feet, board measure, oak and pine covering and sheet piling, at $45 per thousand	35, 910	00
67,200 cubic yards stone filling, at $1 50	100, 800	00
23,100 cubic yards gravelling, at fifty cents	11, 550	00
336,000 pounds bolts spikes, &c., at fifteen cents	50, 400	00
1,300 cubic yards, two abutments, masonry, at $10	13, 000	00
One chute	22, 000	00
11,000 cubic yards excavation, at forty cents	4, 400	00
58,000 cubic yards excavation, at $1	5, 800	00
23,700 cubic yards embankment, at thirty cents	7, 110	00
	452, 570	00
Add ten per cent. for contingencies	45, 257	00
Lower dam complete, with chute	497, 827	00

RECAPITULATION.

Estimated cost of upper dam	$608, 829	70
Estimated cost of middle dam	599, 964	20
Estimated cost of lower dam	497, 827	00
Estimated cost of three dams	1, 706, 620	90
Add estimated cost of three locks, putting them the same as for the canal plan	763, 471	00
Total cost of this plan	2, 460, 091	90

The foregoing estimate is made for the purpose of showing how this plan of improvement will compare with others that have been or will be referred to in regard to cost; the plan is one that has frequently been advocated on account of its supposed cheapness.

The board are of opinion that a weaker dam than the one they have based their estimate upon would not answer in a great river like the Mississippi.

Some improvement could be made in this dam, particularly in regard to the length of the chutes, which would give more facilities for commerce, but would add to the cost.

This plan possesses no advantages over the plan of the canal that will presently be described; on the contrary, the advantages are all on the other side.

It is an important fact, which should not be overlooked, that the Mississippi river has, for the greater portion of the year, a good navigation over the rapids. During two-thirds of an ordinary season no improvement to the navigation is necessary or required.

The board hold that this fact should be prominently kept in view, and whatever plan is adopted, it should be one that will not interfere with the navigation in high stages.

No improvement should be constructed at this place for low-water stages that would itself become an obstruction in high water.

It is true that in the plan of locks and dams a sluice navigation might be made in the dams, which would pass rafts, &c., down stream tolerably well in low water, and which steamboats could ascend in medium high stages, but in order to make a good ascending navigation in moderate stages of the water, much longer chutes would be necessary than those described herein and estimated for.

The cost of maintaining the locks of a canal would be about the same as locks in this plan.

The cost of maintaining the dams, however, would be much greater than that for maintaining the canal, they being much more subject to injury from ice. Well built dams might stand for years without material repairs, but it would not be proper to assume that such would be the case, and therefore an estimate for superintendence and repair is an important item, and as the money for this purpose, as the laws now are, must in all cases come by direct appropriation, delay might some time cause the destruction of the entire work. If we assume that in the course of fifty years a dam would cost as much in superintendence and repairs as the original cost, (and this is deemed by the board a fair estimate,) that would be two per cent. per annum on the entire cost; and as the dams are estimated to cost $1,706,620 90, this would give $34,132 42 annually, and allowing $15,000 for the locks, (the same as in the canal system,) would make the annual cost of maintaining this system of improvement $59,132, to be made by direct appropriations from the treasury.

A law of Congress prohibits the levying of a tax on the produce, &c., passing through the locks.

While the board do not entertain a doubt as to the practicability of carrying out this plan, the fact of the volume of water passing over the rapids is so great as to require no improvement in the navigation for the greater part of the year; and in view of the fact that the adoption of this plan will destroy that navigation, and as the cost is no argument in its favor; and as it has no advantage not possessed by the canal improvement referred to, but on the contrary some disadvantages, the board cannot recommend this plan for adoption. It is accordingly rejected.

V.—*Plan and position of an improvement proposed by G. Edmunds, jr., of Illinois.*

The following plan has been advocated by certain parties in Illinois, and is thus described by G. Edmunds, jr.:

* * * "A dam should be erected from the island at the Upper chain to the Illinois side, and a wall should be built from the west end of the dam down parallel with the Iowa shore, about one (1) mile, thereby deepening the water on the Upper chain, and continuing the water in a regular channel until it falls into deep water below the chain. By this means, a sluice five (5) feet deep on the chain could be produced with a fall within its length of about three and a half (3½) feet per mile—a foot less than the present fall on the Lower chain, and, consequently, giving much less velocity of current. By this mode, all obstructions presented by the Upper chain will be overcome, and the navigation made complete to the head of Spanish chain, a distance of between four and five miles. * * The dam could be constructed by cribs filled with rock, or with brush and stone, say three feet deep, 4,200 feet long, and twenty-four feet wide, containing 11,200 yards, at an expense of $11,200. The wall to consist of earth covered with riprap three feet deep; total, forty-five feet at the base, nine feet on top, and eighteen feet deep on an average, at an expense of $52,800.

"At the head of the dam there must be an ice-breaker of heavy masonry—about 100 yards—at an expense of $2,000, making a total expense of improving the Upper chain of $101,200.

"Continuing the same plan of improvement, commence on the Illinois side of the river, and put in a similar wall from the deep water at the head of Spanish chain, at a distance of say 500 or 600 feet from the east bank, and east of the present steamboat channel to deep water below English chain, a distance of about four miles, in which the river falls about nine and a half feet. By straightening the projection on the east bank of the river, this would present a sluice of four miles in length, in which, by narrowing the sluice at the rate of about ten feet per mile as you go down, an even and regular current may be had at any desired depth.

"Construct a dam from the west bank of the river, near Nashville, to the head of this wall, raising the water three feet, will give a depth of five feet in the sluice, forming an inclined plane of four miles, in which there will be a fall of twelve and a half feet, being at all times less fall per mile and less velocity than on the Lower chain at present.

"The expense of this work will not exceed $355,200, calculated on the same basis as that proposed on the Upper chain. This would perfect the navigation to the head of the Lower chain.

* * * "Construct a dam from the west bank of the river to Fille Rock chute, at the head of the Lower chain; also, from the east shore to Sucker chute, the ends of the dams approaching within about 600 or 800 feet of each other, and constructing two walls like those herein before described, nearly parallel, but approaching each other at the rate of twenty-five feet each per mile until deep water is reached below the chain; then continuing one-fourth of a mile further, diverging at the same rates, forming a chute or sluice 600 to 800 feet wide, and about one and a fourth to one and a half miles long. The dams, walls, and heads of walls constructed as described for Upper chain. This would leave both Sucker and Fille Rock chutes within the sluice, and by raising the dam at the head of the chain three feet, would give about five and a half feet in the Lower chain, with a fall in the sluice, say one and a half miles in length, of about seven and a half feet—less than double the fall now overcome in one-half mile, being only five feet to the mile. * * The dams would cost about $12,000; the heads of the walls about $4,000, and the walls themselves (total

length three miles) $264,000, making a total expense on the Lower chain of $280,000, and a total for the improvement of the entire rapids $736,400."

The board will proceed to point out grave errors into which Mr. Edmunds has fallen.

In his estimate of the cost of the entire improvement it would appear that his plan has economy in its favor; but this is only an appearance, not substantiated by facts. In the first place, he has estimated $11,200 for the cost of a dam from Montrose island to the Illinois shore made of cribs filled with stone.

A stone and brush dam that he refers to is altogether out of the question on such a river as the Mississippi, and would be swept away in one season by the ice.

The dam he proposes will contain 11,200 cubic yards, at the rate of one dollar per yard. It is hardly necessary to compare an estimate at such rates with those upon which other works herein referred to are based.

The board is of the opinion that at any point on the rapids nothing but the most substantial structure should be placed—a dam of loose stone and crib-work should be certainly bolted to the rocks.

The proposed dam for the Upper chain, three feet high, is not sufficient to raise the water 4.2 feet in the sluice, which rise is necessary in order to make it five feet deep in extreme low water. The dams should not be less than 4.2 feet high.

If such a plan should be adopted for passing the Upper chain as is proposed by Mr. Edmunds, the board would suggest that a dam less strong than the one represented in section on the map herewith should not be allowed at this place nor any other on those rapids.

Again, in regard to the wall that should extend from Montrose island down the river parallel to the Iowa shore. This embankment will be subject to as great abrasion as a similar wall for a canal, and should not be of less dimensions. This the board have already established at maximum width on top of ten feet. Mr Edmunds makes the average height of the embankment eighteen feet; this is nearly correct, but he omits to notice the fact that the greater part of Montrose island is under water in high stages, and consequently an embankment will have to be built along the whole length of the island.

In order to make five feet depth in the sluices in extreme low water, the water must be raised 4.2 feet, or else rock must be excavated from the channel. As this improvement is designed to obviate this difficulty, the depth must be had by raising the water surface.

There is already a fall on this chain of one foot to the mile; adding the increased level to this, we would have a fall in the sluice of over five feet per mile, by no means affording good navigation for even the most powerful steamers.

The same observations in regard to the dam at the Upper chain will apply to the dam he proposes near Spanish chain. Mr. Edmunds speaks of straightening up the projections of the east bank along the line of the Illinois shore in the second sluice, but makes no estimate of its cost. This will be found to be no inconsiderable item. for it can only be done by the excavation of a considerable amount of rock.

Again, he proposed to keep the water in the sluice about three feet above the water outside, but no arrangement is made at the lower end for dropping into deep water. (The sluice is supposed to end when it comes to the deep-water channel.) If the embankment is extended a mile further down, widening out gradually so as to distribute this fall over a distance of a mile, there would then be at the lower end of the sluice a current, to be overcome by ascending steamboats, due to the fall of five feet per mile, or the head of water in the sluice, in addition to the regular fall in the river at that place, which is about two feet. If this embankment is not run down in this manner it would be impossible for the most powerful steamboats to ascend the sluice at all. No estimate is made of this very necessary extension of the embankment.

In describing his plan he says: "Raising the water three feet will give five feet depth in the sluice, forming an inclined plane of four miles, in which there will be a fall of 12½ feet."

But if there is only one incline in the sluice, and that begins three feet above the natural level at the head, and gradually falls off to nothing at the end, there will be a large amount of rock excavation necessary in the sluice to make the five feet depth throughout the lower half of it. A full head of three feet must be maintained in the sluice throughout, else there will not be five feet depth at the lower end.

He says: "This plan would perfect the navigation to the head of the lower chain." In a few lines thereafter, he speaks of building a dam to "Fille Rock chute at the head of the Lower chain."

It should be observed, if he regards this as the head of the Lower chain, he has failed to make an improvement of one of the worst places in the rapids, viz: Montebello crossing, about half a mile above Fille Rock chute. There is a fall between these points of over two feet, and the fact that he says "the dam at the head of the sluice would give about 5½ feet on the Lower chain," is evidence that he does not regard Montebello crossing as a part of the Lower chain, because a dam three feet high could not, located where he proposes it, raise the water at Montebello crossing 3½ feet, which it would have to do. In order to get three feet more water in Montebello crossing than there is at present, the dams should be moved further up the river, or raised higher, and to do either would materially increase the cost of the embankment walls of the sluice.

Then, again, the latter are estimated on the same basis as the embankment which he proposes to run from the lower end of Montrose island.

It has been shown in this report that the range between the surfaces of extreme high and lower water at the foot of the rapids is 21.721 feet, and hence his sluice walls, the tops of which are only eighteen feet above the bottom of the river, would be overflowed in even ordinary high water.

In order to be properly protected from this danger the embankment should not be less than 23.721 feet above the surface of extreme low water. The average depth from the head to the foot of the proposed sluice is not less than four and a half feet, (the lower part being in deep water,) and hence will require an embankment about twenty-eight feet instead of eighteen feet high.

With these corrections made, and for the purpose of instituting a fair comparison between this and the other plans of improvement, the board have made the following estimate of its probable cost:

ESTIMATE FOR DAM FROM MONTROSE ISLAND TO THE ILLINOIS SHORE FOR EACH ONE HUNDRED FEET IN LENGTH.

23,301 feet board measure heavy timber for cribs, at $50 per M.	$1,165 05
104 cubic yards loose stone, at $1 50	156 00
90 cubic yards gravelling, at $1	90 00
664 pounds bolts, spikes, &c., at 15 cents	99 60
Total for one hundred feet	1,510 65
4,200 feet in length	$63,447 30
214 cubic yards masonry abutments, at $10	2,140 00
Coffer dams and bailing	25,000 00
Preparing foundation	2,500 00
Total	93,087 30
Contingencies and engineering, 15 per cent	13,962 78
Total for upper dam	107,050 08

97,000 cubic yards of embankment, one mile long, from Montrose island, at 50 cents	$48,500 00
32,244 cubic yards riprap covering, at $2	66,488 00
10,009 cubic yards embankment on Montrose island, at 50 cents	5,004 50
7,022 cubic yards riprap on Montrose island, at $2	14,044 00
	134,036 50
Contingencies and engineering, at 10 per cent	13,403 65
	147,440 15
Total for dam and sluice	$254,490 23

SECOND DAM.

5 miles sluice wall, average height 22 feet	$94.007 60
743,110 cubic yards earth embankment, at 50 cents	371,555 00
181,865 cubic yards riprap, at $1 50	272,797 50
107 cubic yards masonry at head of the wall, at $10	1,070 00
Straightening the projections on the east side of the river in the sluice, 298,129 cubic yards of earth paid for as embankment, 37,037 cubic yards rock, at $2	74,074 00
	813,504 10
Contingencies and engineering, 10 per cent	81,350 41
Total for second dam and sluice	894,854 51

LOWER DAM AND SLUICE.

Dams	$81,407 36
3 miles of embankment; 747,411 cubic yards earth, at 50 cents	373,705 50
124,371 cubic yards riprap, at $2	248,742 00
Head walls: 285 cubic yards masonry, at $10	2,850 00
	706,704 86
Contingencies and engineering, 10 per cent	70,670 48
Lower dam and sluice	777,375 34

RECAPITULATION.

Upper dam and sluice	$254,490 23
Middle dam and sluice	894,854 51
Lower dam and sluice	777,375 34
Total for improvement	1,926,720 08

From this estimate it will be seen that the saving of money in carrying this plan into execution is not as great as it would appear from Mr. Edmunds's estimate.

The board entertain the opinion that, constructed according to the plan of Mr. Edmunds, with the modifications that have been indicated as necessary, it would still fail to produce the result claimed for it, and would consequently not be an adequate improvement. There are too many elements of uncertainty in the plan to warrant the board in recommending it. It is experimental in its character, and would materially exaggerate one of the principal sources of difficulty of these rapids by making the fall several feet greater than it already is. In short, whatever may be the merits of the plan, if it has any, they have not been presented by Mr. Edmunds with sufficient accuracy and regard to detail to warrant the board in giving it further consideration; it is therefore rejected.

VI.—*Plan and position of an improvement by means of an excavated shore channel with an exterior embankment on the Iowa side. Estimate of its probable cost; also of a similar improvement on the Illinois side.*

Lieutenant Warren, in his report of his survey in 1853, says: "Captain Shreve, in his report in 1836, urgently recommends that these rapids be improved by excavating a channel ninety feet wide and five feet deep along the Iowa shore from Keokuk to Nashville, and through the Upper chain, near the foot of Montrose island." He states, "by pursuing this plan, the navigator will have the shore for his guide, and cannot miss the channel in any stage of water; consequently it will not be necessary to excavate a channel more than ninety feet wide, which width can be more easily navigated than a channel 300 feet wide, following the meanderings of the natural channel that now exists between the reefs."

Although this plan is practicable, the board do not concur with Captain Shreve in the opinion that ninety feet width is all that would be required. The fact is, that two ordinary sized steamboats that now navigate the upper Mississippi could not pass each other at all in such a channel, and even a large one could barely thread it. A channel of that kind, with the dimensions proposed by Captain Shreve, is out of the question at the present day.

The board will now describe a plan that could be carried out, and would make a practicable channel, following the ideas of Captain Shreve.

Excavate a channel near the shore 300 feet wide, and with the excavated material and other material that could be obtained from the shore by straightening and smoothing its sides, construct an exterior embankment ten feet wide on top, with slopes of 1½ base to 1 perpendicular, with two feet thickness of riprap on both slopes. The embankment need not necessarily be as high as would be required in a canal, but high enough to be safe from submergence until the main river outside should be navigable. This channel could be run at all times when the river should be low enough to require it.

A channel like this could also be made on the Illinois side, extending from Edmunds's warehouse to Hamilton, but there would be a considerable increase of embankment wall and rock excavation.

The main objection to such a work on that side, however, would be the river channel entrances, being on the Iowa side; it would necessitate the crossing of the river twice, and one of those would be at "Nashville crossing," a difficult place even in an ordinary low water. This plan, therefore, will not be further considered.

If the channel is made continuous from Montrose to Keokuk, to a similar improvement on the Illinois side, from Nauvoo to Hamilton, both in respect to cost, location, and all other advantages, the Iowa side is again preferable.

Such a channel, 300 feet wide and six feet deep, would require the excavation of 3,556,543 cubic yards of material. The proportion of this classed as earth is 437,000 cubic yards, which, deducted from the total, leaves 3,119,543 cubic yards of rock excavation.

By throwing the channel further into the river the total quantity of excavation would be somewhat reduced, but would be almost entirely rock under water. It is evident, however, from an inspection of the profile and river soundings, that to obtain one regular inclined channel 300 feet wide, and six feet deep in low water, would involve an excavation in rock about five feet in depth for a distance of about ten miles.

By throwing it into two inclines the quantity of rock excavation would be reduced to 2,595,555 cubic yards. By means of a temporary coffer-dam or embankment thrown across from the shore to the head of the proposed line of embankment, and the raising of said embankment a few feet above low water, keeping out the river, the excavation inside could be rendered comparatively dry, and most of the rock excavation could be made in the ordinary manner by drilling and blasting, except at and near the lower end, where it would have to be done by the use of coffer-dams. All the stone required for the embankment and riprap on its slopes and top would be obtained from the bed of the channel. The top of the embankment should be two feet above extreme high water, and have the same dimensions as the canal embankment hereinafter to be described.

The following is the estimate of the probable cost of this plan, making the channel five feet deep, with two inclines, the lower one falling $2\frac{1}{10}$ feet per mile:

2,016,055 cubic yards rock excavation, at $2	$4, 032, 110
437,000 cubic yards earth excavation, at 40 cents	174, 800
310,000 cubic yards embankment, at 50 cents	155, 000
Coffer-dams and extra work	100, 000
Contingencies and engineering	200, 000
Total	4, 661, 910

By making the channel 5 feet deep and 200 feet wide the estimated cost will be $3,317,874.

By making the channel 4 feet deep and 300 feet wide the estimated cost will be $3,503,910.

By making the channel 200 feet wide and 4 feet deep the estimated cost will be $2,752,933.

A comparison of side channel improvement just described, with that of the open river channel, in reference to cost, will show the following differences in this respect:

First. Natural channel of the river improved to four feet deep in low water, and 200 feet wide	$2, 647, 785
Side channel four feet deep in low water, and 200 feet wide	2, 752, 933
Difference in favor of the natural channel	105, 148
Second. Natural channel improved to four feet deep in low water, and 300 feet wide	$3, 648, 362
Side channel four feet deep in low water and 300 feet wide	3, 503, 910
Difference in favor of side channel	144, 452
Third. Natural channel improved to five feet deep in low water and 200 feet wide	$3, 504, 182
Side channel five feet deep in low water and 200 feet wide	3, 317, 874
Difference in favor of side channel	186, 308
Fourth. Natural channel improved to 300 feet wide and five feet deep in low water	$5, 034, 350
Side channel five feet deep in low water and 300 feet wide	4, 661, 910
Difference in favor of side channel.	372, 440

From the above comparison it will be observed that in every case except the first, the advantage in regard to cost is in favor of the side channel improvement.

The first and second of the above are not, however, regarded by the board as adequate improvements on account of the want of sufficient depth. They are both accordingly rejected.

The great cost of the latter plans, 300 feet wide and five feet deep, both of the natural and side channels, will cause their rejection.

The other plan of a side channel 200 feet wide and five feet deep, and of the natural channel improved to the same width and depth, shows a difference in cost of $186,308 in favor of the former.

Let us now compare them in other respects:

First. In regard to the time of execution.

It is the opinion of the board that the channel along the shore could be constructed in two years; provided, an amount of money equal to the estimated cost should be placed at the disposal of the superintending engineer. The work would be less liable to interruption from floods or ice, and would not interfere with the navigation of the rapids during its construction.

In the improvement of the river channel the time at which it could be completed is extremely uncertain; the work would necessarily have to be suspended during the greater portion of the year, on account of floods and ice, and would be liable to interruption by sudden rises in the river during the progress of the work. This would be particularly the case if the work should be done with coffer-dams. If it should be done by chiselling and dredging during the low-water season, it would be necessary to suspend work a short time for the passage of each boat and raft.

The contingencies that might arise to increase the cost are much more numerous in the natural channel improvement than in the other. The latter will give for a width of 200 feet excellent navigation, free from all cross-currents, a well defined outline and comparatively straight course.

The natural channel improved to 200 feet in width will remain still tortuous, be exposed to the action of cross-currents, and its outlines would not be well defined. In the side channel the slope of the water surface would be more even throughout, allowing the passage of boats through it that would not have sufficient power to cross the Lower chain in low water. The average current would be about the same in both cases, but in the side channel it would be at no place much more than the average, where, as in the natural channel, it would be very much greater in some places and less in others. The side channel could be navigated in all kinds of weather, by night or by day. In the other, navigation would often have to be suspended at night, in fogs, and during storms.

The difficulties of navigation at night might be somewhat ameliorated, however, by the establishment of floating lights; this would probably become necessary, but they would be of no advantage in fogs and would require continual superintendence and replacing when carried away by rafts or ice.

The advantages, it will seem, are all in favor of the side channel improvement; consequently an improvement of the natural channel of the river cannot be recommended by the board.

VII.—*Plan and position of a canal improvement on the Iowa side. Estimate of its probable cost.*

The following is a description of a canal recommended by General Wilson and taken from his report:

"Construct an independent navigation canal along the Iowa shore, from a point near the present site of the 'Keokuk indicator,' at the city of Keokuk, to a point just below the village of Nashville; the balance of the distance to be overcome by using the natural channel, which from here to the Upper chain is found to contain sufficient water for all purposes. At the Upper chain a through cut two hundred feet wide, six feet deep, and 2.400 feet long, will be necessary.

"A careful calculation shows that 54,882.29 cubic yards will have to be excavated. * * * * * * *

"The estimated dimensions of the canal are as follows: length, 7.6 miles, width on the water surface, 300 feet; and depth at the lowest stage, six feet, (with an alternate of five feet.) The stage of water here referred to is that of 1864, which was ten inches lower than any other season recorded, and about fifteen inches below that of 1866, which may be taken as an average.

"The canal would therefore pass boats drawing full six feet, and have a sufficient depth in addition for perfect safety during seasons of average low water. It should run the entire distance except at one or two low points along the shore in the bed of the river; the river embankment, for strength and economy, should be constructed of earth, and securely covered inside and out with a well-made riprap of broken stone, so as to render it entirely safe against the running ice and freshets. It will require two lift-locks and one guard-lock; the lift-locks to be three hundred and fifty feet between the mitre-sills, eighty feet wide between the tops of chamber walls, (seventy-eight feet at the water surface,) and to lift respectively eight and ten and one-third feet. The lower locks should also be furnished with a set of guard-gates for security against floods, and the guard-lock proper, at the head of the canal, should be so arranged as to admit of being used as a lift-lock whenever required, which would be after the water in the river at the head of the canal had raised three feet above the extreme low-water mark.

"This construction will admit of nine feet draught, the utmost likely ever to be required for purposes of navigation, either by vessels of commerce or war, and will allow the canal to be used at all ordinary stages of the river so that ascending boats may avail themselves of the slack-water of the canal to overcome the increased currents of high water in the open river. * *

"It will be observed that in this canal a greater depth at extreme low water is provided for than is required by the present ruling depth of the river above and below; but as the work is intended to be permanent, it should be constructed so as to meet all possible contingencies of national defence and river improvement in the future. * * * This system of navigation, providing in the fullest manner for the improvement of the rapids, will cost $3,390,000.

"Should it be deemed inadmissible or unnecessary by Congress to provide, in the dimensions of the proposed canal, for the ultimate development of the river, above and below, the cost may be reduced to $2,731,722 96, by reducing the depth of water in the channel and throughout to five feet instead of six, so as to give good navigation for boats drawing four feet water. This may be ultimately diminished by the sum of $34,155 should it be found unnecessary to construct the stone pier or wing-dam estimated for at the foot of Montrose island. * * * * * * *

"At the head of the canal is located a guard-lock, with walls 21⅔ feet high, or two feet above high-water mark. This will be used as a lift-lock when the water in the river is more than three feet above low water. It will have a favorable location, independent of the river, and the cost of bailing and draining will be comparatively small.

"A lock of eight feet lift is located at a point about 5.6 miles from the upper end, and two miles from Keokuk. This lock also has a location independent of the river, and not expensive for bailing and draining.

"At the lower end a lock of ten and one-third feet lift is located entirely in the river. * * * * * * *

"Its location is such as to make six feet of water on the mitre-sill at low water. The walls will be twenty-eight and two-thirds feet high, which will carry them two feet above high water. In the centre is placed an extra set of gates, which reverse in closing, to keep high water out of the canal.

"The river bank of the canal for the entire length is to be raised four feet above the high water of 1851, and is to be twenty feet wide on the top, with an outside slope of one and a half to one, and an inside slope of one and a quarter to one, with a heavy riprap wall on the outside, and a lighter one on the inside and over the top. The height of the bank will vary from eighteen to thirty feet above the bed of the river.

"A large amount of rock excavation will be necessary at the guard-lock, and for one mile below, in order to obtain six feet depth in low water in the river; also at the middle lock and for a half mile below.

"On the flats from four to eight feet of excavation are earth, and the balance rock. The excavated material will generally be used in the embankment and riprap walls, and can be hauled from the pit directly to the point required, and thus save the expense of borrowing the material from other points to form the bank.

"The character of the earth in the adjoining hills or banks is very favorable for forming solid and water-tight banks, but for a considerable part of the distance the rock runs so high on the hills that it will be expensive obtaining the same, and for this reason a high price has been used in the estimate.

"There is probably no stone on this side of the river that will answer for face stone for the locks, but for the backing and vertical wall stone can mostly be obtained here, and perhaps a large portion of the excavated rock can be used for this purpose.

"On the Illinois or east side of the river, within a reasonable distance of the work, are located splendid quarries of magnesium and other limestone, and which can be delivered on the ice during the winter, or in boats during the summer.

* * * * *

"If a dam were built across the river at Nashville, raising the water four feet, the most of the rock excavation in the canal, and a very large part of that in the channel at the Upper chain, would be avoided, and the cost of the whole work materially reduced. Such a dam would, however, prevent boats from navigating the river, and compel them to use the canal even when the water in the river is of sufficient depth; it is therefore inadmissible.

"The annexed estimates for the canal are based on three hundred feet width and six feet depth; but it will be seen that by reducing the width to two hundred feet, where the excavation of earth and rock occurs, a saving of two hundred and eighty thousand dollars can be made. This reduction would occur in detached portions, where the canal leaves the river, and, in my opinion, would answer every purpose. If it should afterwards be considered necessary, the additional one hundred feet could be excavated during the suspension of navigation.

"In order to obtain the materials for embankment, and to locate a good line for the canal, it would be necessary to alter in several places the line of the public highway, and of the Keokuk and Fort Madison railroad. The total length of each which requires alteration is about three miles, and the cost is embraced in the annexed estimates.

"There are several small streams which will have to be taken in, and as the river guard bank must be carried very much above the surface of the water in the canal, no waste-weirs can be constructed at these points. The most important of these streams is Price's creek.

"If they in time of freshets bring too much water, it will have to be passed off in sluices, which must be constructed around the lift-locks.

"The cost of these sluices is provided for in these estimates.

* * * * * *

"TIME REQUIRED TO CONSTRUCT THE WORK.

"In the construction of the canal, the first season should be occupied in excavating a part of the canal, putting in the bottom of the outside of the riprap wall for the entire length, and raising it from ten to fifteen feet high. This can be done, and allow the high water of the next spring to overflow it and do no harm. During the second year the excavation should be continued, the earth for embankment put in, and the outside riprap wall completed. The third season the excavation for the canal should be finished, the inside riprap wall put in, and the remainder of the bank and walls completed.

"For the locks, the first season should be occupied in procuring, preparing, and delivering materials at the work. The second season the coffer-dams should be put in, the lock-pits excavated, the foundations prepared, and portions of the masonry laid. During the third year the masonry, gates, embankment, and all the other work should be completed.

"In this manner, if the work is commenced in the ensuing summer, the whole can be completed in the fall of 1869, or in about two and a half years.

"COST OF MAINTENANCE.

* * * * * *

"If the demands of commerce shall ever require a double set of locks, the proposed ones can be so located on one side of the centre as to have sufficient room for the construction of other locks by their side, without in any manner disturbing the outside river embankment wall.

"In the prism of the canal, and in the locks, provision is made for a depth of nine feet, when there is a rise of three feet in the river, in order that boats of eight feet draught may pass through the canal.

"The gates are to be of wood, properly arched on the upper side, and strengthened with wrought-iron braces or hog chains on the lower side. This, it is believed, will answer the purpose designed, and the expense will be much less than that of iron gates. It is proposed to hang the gates on the suspension plan, which has been successfully applied to the locks on the St. Mary's canal, between Lakes Huron and Superior. * * * *

"Detailed estimates of the cost of all the works are hereto annexed, of which the following is a summary:

"For a canal 300 feet wide and six feet deep, with a channel at Montrose six feet deep—

Cost of canal embankment and walls	$1, 717, 480
Cost of lift-locks	371, 265
Cost of middle lock	244, 910
Cost of guard lock	242, 822
Total cost of canal and lock	2, 576, 477
Cost of channel and pier at Montrose	619, 155
Total	3, 195, 632
Add contingencies and engineering	194, 368
Total cost	3, 390, 000

"For a canal 300 feet wide in embankment, and 200 feet in excavation, and six feet deep, with a channel at Montrose six feet deep—

Cost of canal embankment and walls	$1, 454, 680
Cost of lower lift-lock	371, 265

Cost of middle lift-lock	$244, 910
Cost of guard-lock	242, 822
Total cost of canal and locks	2, 313, 677
Cost of channel and pier at Montrose	619, 155
Total	2, 932, 832
Add contingencies and engineering	177, 168
Total	3, 110, 000

"For a canal 300 feet wide and five feet deep, with a channel at Montrose five feet deep—

Total for a canal six feet deep, and locks as above		$2, 576, 477
Deduct difference in cost for five feet		220, 000
Cost of canal and locks		2, 356, 477
Total for channel and pier at Montrose	$619, 155	
Deduct difference in cost for five feet	157, 500	
Cost of channel and pier		461, 655
Total		2, 818, 132
Add for contingencies and engineering		171, 868
Total cost		2, 990, 000

"For a canal 300 feet wide in embankment, 200 feet in excavation, and five feet deep, with a channel at Montrose five feet deep—

Total for a canal six feet deep, and locks as above		$2, 313, 677
Deduct difference in cost for five feet		220, 000
Cost of canal and locks		2, 093, 677
Total for channel and pier as above	$619, 155	
Deduct difference in cost for five feet	157, 500	
Cost of channel and pier		461, 655
Total		2, 555, 332
Add for contingencies and engineering		154, 668
Total cost		2, 710, 000"

The board have already, in their report of April 13, 1867, made known to the Chief of Engineers their views in regard to the plan and location of the improvement that they consider the best adapted to accommodate the demands of commerce, and which will give all, or at least the most important advantages of any plan that has been considered, and with considerably less expense than most of them. That plan, it will be remembered, is essentially the same as that recommended by General Wilson, with certain modifications, which will lessen the cost without changing the character of the improvement.

The following is a detailed estimate of the cost of this plan:

Estimate of the cost of constructing 7.6 miles of canal, from Nashville to Keokuk, for the improvement of the Des Moines rapids of the Mississippi river.

For a canal 300 feet wide in embankment and 250 feet in excavation, and 5 feet:

Grubbing and clearing	$3,000 00
1½ mile of bailing and draining, at $30,000	45,000 00
161,440 cubic yards excavation of rock, at $2	322,880 00
315,870 cubic yards excavation of earth, at 40 cents	126,348 00
651,500 cubic yards embankment, at 50 cents	325,750 00
203,500 cubic yards hauled from excavation, at 25 cents	50,875 00
10,000 cubic yards lining, at 60 cents	6,000 00
50,000 cubic yards puddling, at 25 cents	12,500 00
88,000 cubic yards loose stone in riprap wall, at $1 50	132,000 00
80,000 cubic yards stone hauled from excavation, 75 cents	60,000 00
1,000 cubic yards slope and pavement wall, at $2	2,000 00
5,000 cubic yards vertical wall in cement, at $5	25,000 00
3,000 cubic yards vertical wall laid dry, at $4	12,000 00
3 miles changing lines of railroad, at $8,000	24,000 00
3 miles changing lines of public roads, at $1,000	3,000 00
	1,150,353 00

Estimate of the cost of constructing lower lock of 10½ feet lift with walls 23 feet high, for the improvement of the Des Moines.

Grubbing and clearing	$100 00
Bailing and draining	40,000 00
10,860 cubic yards excavation of rock, at $3	32,580 00
1,000 cubic yards excavation of earth, at 60 cents	600 00
45,000 cubic yards embankment, at 50 cents	22,500 00
4,000 cubic yards lining, at 75 cents	3,000 00
8,000 cubic yards puddling, at 30 cents	2,400 00
1,000 cubic yards slope and pavement walls, at $2	2,000 00
900 cubic yards loose stone, at $1 50	1,350 00
4,650 cubic yards vertical in hydraulic cement, at $6	27,900 00
450 cubic yards vertical laid dry, $4 50	2,025 00
9,975 cubic yards masonry in lock walls, at $13	129,675 00
500 cubic yards masonry in lock walls, at $6	3,000 00
73,300 feet board measure white oak timber and plank, at $1	7,330 00
50,000 feet white pine, at 60 cents	3,000 00
72,000 pounds wrought iron, at 18 cents	12,760 00
28,450 pounds cast iron, at 12 cents	3,414 00
4,500 pounds spikes and nails, at 12 cents	540 00
160 lineal feet snubbing posts, sulphur, &c., at $1	160 00
Sand cement for irons let into masonry	500 00
Painting upper part of gates	100 00
130 lineal feet superstructure for a drawbridge, at $50	6,500 00
Fixtures for opening valves	1,000 00
House for lock tender	1,500 00
	304,134 00

Estimate of the cost of constructing middle lock of 8 feet lift for the improvement of the Des Moines rapids.

Grubbing and clearing	$300 00
Bailing and draining	10,000 00
17,100 cubic yards excavation of rock, at $2 50	42,750 00
19,200 cubic yards excavation of earth, at 50 cents	9,600 00
12,000 cubic yards embankment, at 50 cents	6,000 00
4,000 cubic yards lining, at 75 cents	3,000 00
8,000 cubic yards puddling, at 30 cents	2,400 00
500 cubic yards slope wall and pavement, at $2	1,000 00
800 cubic yards loose stone, at $1 50	1,200 00
2,500 cubic yards vertical wall in hydraulic cement, at $6	15,000 00
300 cubic yards vertical wall laid dry, at $4 50	1,350 00

8,192 cubic yards masonry in lock walls, at $13	$106,476 00
300 cubic yards cement masonry, at $6	1,800 00
64,000 feet board measure white-oak timber and plank, at $100	6,400 00
42,000 feet white pine timber and plank, at $60	2,520 00
64,300 pounds wrought iron, at 18 cents	11,574 00
27,500 pounds cast iron, at 12 cents	3,300 00
4,000 pounds spikes and nails, at 12 cents	480 00
160 lineal feet snubbing posts, at $1	160 00
Sulphur and sand cement for irons let into masonry	500 00
Painting upper part of gates	100 00
130 lineal feet superstructure for drawbridge, at $50	6,500 00
Fixtures for opening and closing gates	1,000 00
House for lock tender	1,500 00
	$234,930 00

Estimate of cost of constructing guard-lock of 9 *feet lift, with* 5 *feet depth of water, and three feet extra walls,* 18′ 8″, *with head of lock* 20′ 8″ *high, for the improvement of the Des Moines rapids.*

Grubbing and clearing	$300 00
Bailing and draining	13,500 00
19,200 cubic yards excavation of earth, at 50 cents	9,600 00
17,100 cubic yards excavation of rock, at $250	42,750 00
11,500 cubic yards embankment, at 50 cents	5,750 00
4,000 cubic yards lining, at 75 cents	3,000 00
8,000 cubic yards puddling, at 30 cents	2,400 00
800 cubic yards slope and pavement walls, at $2	1,600 00
950 cubic yards loose stone, at $1 50	1,425 00
1,500 cubic yards vertical wall in hydraulic cement, at $6	9,000 00
400 cubic yards vertical wall laid dry, at $4 50	1,800 00
7,598 cubic yards masonry, at $13	98,774 00
400 cubic yards concrete masonry, at $6	2,400 00
73,000 feet board measure white-oak timber and plank, at $100	7,300 00
9,000 feet white pine timber and plank, at $60	540 00
62,000 pounds wrought iron, at 18 cents	11,160 00
23,900 pounds cast iron, at 12 cents	2 868 00
4,000 pounds spikes and nails, at 12 cents	480 00
160 lineal feet snubbing posts, at $1	160 00
Sulphur and sand cement	500 00
Painting upper part of gates	100 00
130 lineal feet superstructure for drawbridge, at $50	6,500 00
Fixtures for opening and closing gates	1,000 00
House for lock tender	1,500 00
	224,407 00

Estimate of the cost of excavating a channel and constructing a pier at the Upper chain, near Montrose island, for the improvement of the Des Moines rapids.

Excavating a channel 200 feet wide and 5 feet deep:		
Bailing and draining, including coffer-dams	$130,000 00	
42,500 cubic yards excavation of rock, at $7	297,500 00	
		$427,500 00
Constructing pier from foot of island:		
Bailing and draining	$10,000 00	
1,208 cubic yards masonry in pier, at $10	12,080 00	
350 cubic yards coping in pier, at $20	7,000 00	
11,600 pounds wrought-iron dowels and clamps, at 15 cents	1,740 00	
667 putting dowel bolts into masonry, at $3	2,001 00	
667 putting clamps into masonry, at $2	1,334 00	
Total cost of channel and pier		34,155 00
		461,655 00

SUMMARY OF ESTIMATES.

Cost of canal		$1, 150, 353 00
Cost of lower lock	$304, 134 00	
Cost of middle lock	234, 930 00	
Cost of guard-lock	224, 407 00	
		763, 471 00
Cost of channel and pier at Montrose		461, 655 00
		2, 375, 479 00
Contingencies and engineering		154, 521 00
Total		2, 530, 000 00

VIII.—*Plan and position of a canal improvement on the Illinois side of the river. Estimate of its probable cost.*

It has been proposed to make a canal on the Illinois side of the river, of similar dimensions to the one recommended by the board. As this plan has many advocates in the State of Illinois, the board will describe it and make an estimate of its cost.

Commencing on the Iowa side at Montrose, an improvement should be made for passing the "Upper chain," after which there is good navigation as far as Nashville. Whatever may be the plan adopted for the canal improvement on the Iowa side, the same will be applicable for the one on the Illinois side. The board will therefore assume that they are identical, and the estimate cost of this part will be the same in both cases. From Nashville following the river channel, cross over to the Illinois side, and commence a canal in the deep water near Edmunds's warehouse, by excavating through the point of land at that place, and then building an embankment parallel to the Illinois shore and about 300 feet from it, ending in deep water just below the Hamilton ferry dike. An interior embankment to be built from the bluffs at Cheney's creek to the same point where should be located the lower or outlet lock. The canal to be provided with two lift-locks and one guard-lock, the middle-lock about two miles above the lower one, the guard-lock at the head.

All the details as to size and general arrangement of the locks and the size and structure of the embankment, to be the same as in the case of the canal recommended by the board.

The steamboat channel near Nashville strikes directly across from the Iowa to the Illinois side, and in extreme low water affords less than two and one-half feet depth. This difficulty could only be obviated in two ways, either by throwing a dam across the river to the Iowa shore from the head of the canal, or by the excavation of the rock from the bed of the river.

Though the former plan would doubtless be the most economical, the fact that it would destroy the navigation in the river, and force every craft into the canal in all stages, must prevent its application; and a channel should be cut from the deep water on the Illinois side to the deep water channel on the Iowa side, at least 300 feet wide and five feet deep in extreme low water.

The following is the estimated cost of this plan of improvement:

For a canal 300 feet wide in embankment, and 250 feet in excavation, and five feet deep, extending from Edmunds's warehouse to the Hamilton ferry dike, with an excavated channel through "Upper chain" and a pier from Montrose island about one mile long.

Grubbing and clearing	$3,000 00
1½ miles of bailing and draining, at $30,000	45,000 00
243,000 cubic yards excavation of rock, at $2	486,000 00

320,000 cubic yards excavation of earth, at 40 cents	$128,000 00
731,000 cubic yards embankment, at 50 cents	365,000 00
205,000 cubic yards embankment hauled from excavation, at 25 cents	51,250 00
12,000 cubic yards lining, at 60 cents	7,200 00
52,000 cubic yards puddling, at 25 cents	13,000 00
107,000 cubic yards loose stone in riprap wall, at $1 50	160,500 00
80,000 cubic yards loose stone in riprap wall, hauled from excavation, at 75 cents	60,000 00
1,000 cubic yards slope and pavement wall, at $2	2,000 00
5,000 cubic yards vertical wall in cement, at $5	25,000 00
3,000 cubic yards vertical wall laid dry, at $4	12,000 00
Amount	1,358,450 00
3 locks, including lock sections, (the same as for the canal on the Iowa side)	763,471 00
Channel and pier at Upper chain, (the same as for the canal on the Iowa side)	461,655 00
53,333 cubic yards rock excavation at Nashville crossing, at $10	533,333 00
Contingencies and engineering	154,521 00
Total	3,271,430 00

Another plan of canal on the Illinois side has been considered by the board, viz: To commence at the Nauvoo steamboat landing, with an embankment in the river; thence continue the line of the canal along the low ground near the water's edge, and excavate the prism until a point below "Joe Smith's Mormon Hotel" is reached. From here continue the line by building an embankment in the river to the point near Edmunds's warehouse, where the canal just described begins, and the rest will be the same as the latter. This plan will require much more rock excavation, more embankment, higher lock-walls and gates, as four more feet lift will have to be added. This plan has no advantages not possessed by the other, and as it requires about four miles more of canal construction, would involve a great increase in cost. In fact, it has positive disadvantages, and will, therefore, not be further noticed.

IX.—*Comparative advantages and disadvantages of the plan of a canal on the Iowa side, with that of an excavated side channel, and of the canal on the Illinois side.*

The board having described the various plans proposed for improving the navigation of the Des Moines rapids, some of which have for reasons given been rejected, will now compare the plan they have recommended with that of the excavated side channel, and then with that of the canal on the Illinois side of the river, both in regard to advantages and cost.

The plan of the canal from Nashville to Keokuk as recommended by the board, in connection with an excavated channel through the Upper chain, and a low dam from Montrose island to the Illinois shore, would, it is believed, afford all the advantages to commerce and navigation which could be obtained at any reasonable cost, or by means of any improvement yet suggested, and would be subject to no disadvantages that would be obviated by any other plan:

First. It would overcome certainly and entirely all the difficulties of navigating the rapids. There is no doubt in regard to the practical result that will be accomplished by its execution.

Second. The canal will give five feet navigation in extreme low water, and its depth in all stages of the river will be sufficient to pass any boats that the bars in the river would permit to reach it; and if at any future time the river should be improved, the cost of increasing the depth to even six feet would not be nearly as great, with this plan, as with that of the excavated side channel.

Third. It is the shortest line from the head to the foot of the rapids. The river channel above the rapids runs close to the Iowa shore near Montrose, and the lower lock of the canal will be located in the deep water at the upper end of Keokuk, affording a good landing place for boats waiting to enter the lock.

Fourth. It would not in the slightest degree interfere with or obstruct the navigation of the river, either in high or low water, so that boats and rafts preferring to do so may always pass outside of the canal; the only necessity that will compel the use of the canal will be the want of sufficient depth of water in the open river, or inability to stem the rapid current.

Fifth. The water in the canal being slack, boats may ascend almost as quickly as they descend; the current will no longer be an obstacle. At the present time it takes a loaded boat of considerable power five hours to ascend from Keokuk to Montrose in low water, and almost as much in high water. Allowing two hours for descending in low water, (they have to run very carefully,) will make seven hours for the round trip in low water. The same boats in the canal will make in descending, running time 1¼ hours, detention at the locks one hour, making 2¼ hours. The ascending time will be about 2½ hours. Total for the round trip 4¾ hours. Different steamers will give somewhat different results, but it is believed actual experience will show this to be nearly correct. A towing steamer, with heavily loaded barges going up, would be proportionally longer on the rapids.

Sixth. It will give good navigation for all crafts on the river. It can be run with equal facility, up or down, in all kinds of weather, by night as well as by day, and will be perfectly safe at all times.

Seventh. It is believed that the single set of locks will be sufficient for some years to accommodate the commerce of this river, but they can be so located that at any future time, in case it should become desirable or necessary, another set of locks can be placed beside the first. A double set of locks and guard-locks could, without difficulty, pass four boats per hour, either up or down, and double that number if half were going in one direction and half in the other.

Eighth. The canal will afford a capacious, convenient, and safe harbor for steamboats or naval vessels during the winter. This is merely an incidental advantage, but one that is entitled to some consideration on account of the pressing want of such a harbor for boats navigating the upper Mississippi.

Ninth. It would afford admirable sites for dry-docks, which could be constructed near the middle locks at comparatively little cost.

The only disadvantage of the canal, as compared with the shore channel, that the board are able to discover, is the annual cost of repairs and superintendence. There would be little else than the lock-gates to be kept in repair. It has been estimated that repairs and superintendence will cost $15,000 per annum, which is less than one-third the interest at six per cent. on the difference of cost of the two plans. The embankment and lock-walls may be considered as permanent structures.

The side channel will to some extent interfere and obstruct the navigation of the river. The embankment being built up to Montrose island, and the channel of the river being between the island and the Iowa shore, it will be necessary for all rafts or boats, as soon as the water attains a stage low enough to prevent their passing the Upper chain, between the Illinois shore and Montrose island, to go through the side channel. In other words, the natural channel of the river is obstructed as soon as the Upper chain becomes an obstruction, and boats would be compelled to pass through the side channel, whether they desired to do so or not. If they should wish to land on the Illinois side, between the head and foot of the rapids, they could do it only by following the old route on the Illinois side, all the way—an impossibility with some steamers in low water. The side channel, being only 200 feet wide, will not afford as good navigation as the canal, which will for the most part be 300 feet wide.

It would not overcome all the difficulties of navigation, for one of those difficulties consists in a very rapid current which ascending boats have to stem. It would still be the case with this improvement.

It will require a longer time for a boat to ascend in the side channel than in the canal, but less to descend. The difference for the round trip would be greatly in favor of the canal.

The side channel will not afford a safe, commodious, and capacious harbor for boats in the winter, and will not afford advantageous sites for dry docks.

Without reference to the cost of the two plans, the board are of the opinion that the canal plan is preferable to the proposed side channel.

The estimated cost of the canal, 300 feet wide in embankment and 250 feet wide in excavation, and five feet deep, is	$2, 530, 000
The estimated cost of the side-channel improvement, 200 feet wide, five feet deep, is	3, 317, 874
Difference in favor of the canal is	787, 874

From this it will be seen that that the canal plan has the additional advantage of economy. The plan of the proposed side channel cannot therefore be recommended by the board.

Comparison of the plan proposed by the board with the plan of a canal on the Illinois side, beginning at Edmunds's warehouse and ending at Hamilton, with the natural channel improved at the Upper chain, in the same manner in each case.

The board at their second meeting had laid before them by General Wilson several communications on the subject of the improvement of the rapids, two of which were written by Mr. G. Edmunds, jr., of Illinois; one addressed to "General Warren, and other topographical engineers," which had previously been received and considered, and bearing the date of April 15, 1867; the other addressed to the Secretary of War, dated Sonora, Illinois, May 31, 1867.

The purport of these communications is to show the benefits to be obtained by locating a canal improvement on the Illinois side of the river, instead of on the Iowa side, "having reference to cost of construction, advantages to navigation, and the general improvement of the country." In regard to the location of the work on the Illinois side, Mr. Edmunds says:

* * * * * *

"I have come to the conclusion that the work proposed by the government, to wit, the construction of a canal for the purpose of navigation, can be done on this side (meaning the Illinois side) of the river at very much less expense than on the other side, and the advantages to navigation would be the same, and hydraulic power would be created which will not be excelled in this country.

"The cost of construction will, in my opinion, be at least $500,000 less on this side of the river than on the other. The construction of the work will not in the least interfere with the navigation of the present channel of the river, with keel or steamboat channel, during its construction, or after its completion. * * * * * *

"The wall to be built in the river would be on the west side of French channel and east of the present steamboat channel, and there would be sufficient depth of water to enter the canal with, from the pool above, without any excavation of rock whatever.

"A temporary dam can be thrown from the shore to the outer wall of the canal, and the rock and earth transported by rail from the quarries and clay banks to the wall; and as the wall progresses down the river, would exclude the water from the canal, so that any unevenness of its bottom from rock or projecting points could be as easily removed as upon the shore.

"The dimension rock for the locks could be transported directly from the quarries, immediately upon the bank of the river, to the locks without handling, while, if the canal is constructed on the Iowa side, the dimension rock must all be transported from this side, at largely more expense than required for the work on this side. The locks would cost no more on this side than on the other, the great difference being in the expense of transportation and the facilities of handling. There would probably be no necessity of excavation below the middle lock to enable boats drawing five feet water to pass.

"The length of the canal will be substantially the same on either side, between seven and a quarter and seven and a half miles. * * * To enter the canal at Nashville will require a large amount of rock excavation, while none will be required on this side. The construction of the canal on this side will not interfere in any degree with any other public work, while its construction on the other side will require considerable outlay in changing the Keokuk and Mount Pleasant railroad.

"The canal on this side could as easily be five hundred as three hundred feet in width, and would necessarily furnish additional facilities for navigation, passing and repassing of boats, &c. It would furnish an inexhaustible supply of water for hydraulic purposes, which would not interfere with the usefulness of the canal for purposes of navigation. * * * The construction of this canal presents precisely this position. If made in Iowa, navigation is to be benefited. If in Illinois, navigation is to be equally benefited, and the great manufacturing interests of the country advanced. * * * Should it be found that the work can be constructed on this side at the same expense, and will be of equal advantage to navigation, the canal should be located here."

In his letter to the Hon. Secretary of War, Mr. Edmunds says: "There is now a company chartered in this State for the purpose of doing the work; that company will at any time undertake to do the work on this (Illinois) side of the river for $250,000 less than it can be done in Iowa, and give ample security to the government for performance on their part, and to produce the desired depth of water in the canal."

The board have given their close attention to the project of a canal on the Illinois side of the river, and, having carefully examined the maps and profiles of General Wilson's survey, have made an estimate of the probable cost of the work; (this estimate has already been given.) This canal and the one recommended by the board are assumed to have the same dimensions in every respect, and to give the same depth.

The arguments of Mr. Edmunds in favor of the location of the work on the Illinois side will now be considered.

The board are unanimously of the opinion that Mr. Edmunds errs when he says the work can be done at less expense on the Illinois side than on the Iowa side. The estimated cost of the two works has already been given. A comparison of those estimates will show a difference of $741,430 in favor of the Iowa side. He asserts that it will cost less by so many dollars, but he does not give sufficient data by which others may test the accuracy of his conclusions.

The board would respectfully call the attention of the Chief of Engineers to their estimates for comparison in regard to cost.

Again he errs when he says the advantages to navigation would be the same in both cases.

The fact that the canal on the Illinois side necessitates the crossing of the river twice to pass the rapids is sufficient evidence of itself that it has not the same advantages as the canal on the Iowa side But when it is considered that one crossing has to be made near Nashville, where, during the low water of 1864, as has been already stated, there was only little more than two feet depth, what then would be the use of five feet in the canal?

It should be remembered that it will become necessary to cut a channel in the river bed of at least the same width and depth of the canal, and in a direction almost perpendicular to the thread of the current. Such a channel would be not only dangerous of dark nights, but in stormy and foggy weather would be almost impassable.

The board are of the opinion that the advantages to navigation of the two plans are by no means the same in both cases, and that the one on the Iowa side is preferable in all respects.

The board agree with Mr. Edmunds in regard to the fact that a great hydraulic power can be developed equal in both cases; that the Illinois side is preferable to the Iowa side for its development, the low ground in the vicinity of the lower lock affording ample room for the erection of mills for using this hydraulic power.

The board have no hesitancy in saying, if the object of this improvement is to develop a great water power, that the Illinois side is the one that should be selected for that purpose; but if this is the primary object for their consideration, or if it even enters as an important element in the solution of the problem, the board have mistaken the object of their mission.

In the order convening the board the subject of the improvement of the navigation "has been committed to it." Nothing is said about the development of water power.

The questions before the board are of a national character, and the work proposed a national work; the development of local interests has, therefore, not been considered.

Mr. Edmunds states that "the construction of this canal presents precisely this position: if made in Iowa, navigation only is to be benefited; if in Illinois, navigation is to be equally benefited, and the great manufacturing interests of the country materially advanced."

This statement does not present the case correctly.

1st. It does not follow that "if made in Iowa, navigation only is to be benefited." If the government should think proper to connect hydraulic power with the canal, it can be done on the Iowa side, although not so advantageously or cheaply to the private parties who might be interested, yet with the same general results to the government and the country, only that the works would be in Iowa instead of Illinois.

2d. Navigation is not to be equally benefited by the location of the canal on either side, for the reason that a better and more convenient navigation for the public will be obtained by its construction on the Iowa side, and because two unnecessary crossings of the river will thereby be saved to the craft navigating the stream for all time.

He errs again when he says the construction of the work will not in the least interfere with the navigation of the present channel of the river. By referring to the map of the rapids submitted herewith it will be seen that the steamboat channel from Waggoner's warehouse to "Montebello crossing" runs close to the Illinois shore. If the canal should be made three hundred feet wide a part of the exterior embankment must be built in the channel itself, and, consequently, will make it narrower, and hence it will interfere with the present steamboat channel. But he says, in another part of his communication, as one of the advantages in favor of the Illinois side, that "the canal can as easily be five hundred feet wide as three hundred feet." If, then, the canal is made five hundred feet wide, it will throw the embankment beyond the present steamboat channel, taking it into the canal, thereby destroying entirely the navigation of the steamboat channel in low water. The fact is, a canal five hundred feet wide on the Iowa side would interfere less with the navigation of the river than one of the same width on the Illinois side, both during the process of construction and after completion.

The manner of building the embankment down stream, with a temporary dam at the head, so as to exclude the water after a certain distance has been attained, as proposed by him, is equally practicable on the Iowa side.

The statement made in Mr. Edmunds's paper referring to the supposed quarry advantages on the Illinois side conveys an erroneous impression, for if it even be assumed that all the stone for the locks could only be procured from the quarries of Mr. Edmunds on that side, the stone would still have to be boated from the quarries to the locks on either side of the river.

The difference in cost of transporting stone from the said quarries on the Illinois side could only be such as would appertain to the necessity of obliquely crossing the river, instead of running only up or down the stream, which could not be a material item.

It is known, however, that there is a quarry of stone of similar general character to that in Mr. Edmunds's quarry, on Price's creek, on the Iowa side, which may furnish good material for the locks.

He states that there would probably be no necessity for excavation below the middle lock. This will depend altogether on the location and lift of the locks. The Illinois side has no advantage over the Iowa side in this respect.

The length of the canal on each side is very nearly the same, but the difference is in favor of the Iowa side, being a little more than one thousand feet shorter.

There will be some rock excavation necessary in order to enter the canal at Nashville, but it will be an insignificant matter in comparison with excavating a channel at "Nashville crossing," in order to reach the head of the canal on the Illinois side.

The construction of the work on the Iowa side, it is true, will necessitate the changing of the location of the Keokuk and Mount Pleasant railroad and the public road in several places, for short distances, making, in all, about three miles. This item, however, is included in the estimates.

The supply of water for hydraulic purposes, if that is an important consideration, will be no greater on the Illinois side than on the Iowa side.

The proposition of Judge Edmunds, to build the work on the Illinois side for less than it can be done on the Iowa side, is no argument in its favor. If the work is to be let in that manner, viz., to the parties who will build it the cheapest, choosing their own location, there will doubtless be found those on the Iowa side who will offer quite as favorable terms to the government.

The items that make the difference in cost are, the greater length of the canal on the Illinois side by 1,056 feet; the extra interior embankment from Cheney's creek to the outlet lock; the embankment along part of the canal being in deep water, and the excavation of a channel in the river at Nashville crossing.

For the foregoing reasons, the board are unanimous in their opinion that the Iowa side is preferable to the Illinois side for the location of a canal designed for the improvement of the navigation of the Mississippi river at the Des Moines rapids, "having reference to expense of construction and advantages to navigation." How far either would have the advantage in regard to the improvement of the country has not been investigated by the board. The subject, as presented to them, was understood to be the improvement of the navigation of the river.

LIVERMORE'S IMPROVED CHUTE.

The plan and model of an improved chute for rivers, and as a substitute for canal locks, together with a model of the same, having been submitted to this board, accompanied with the able report and description of Alonzo Livermore, civil engineer, its inventor and patentee, we have examined with care. The plan and model were further explained by Mr. Roberts, one of the board, who had previously examined them in company with Mr. Livermore.

The primary object of this invention is to secure a slack-water and chute navigation by the expenditure of a greatly reduced quantity of water, compared with the quantity required to maintain a navigation through a plain, unobstructed chute, by the introduction of cross bottom walls and side walls, with lips at intervals, so arranged as to divide the fall into small lifts, and create reaction and retardation of the whole current.

It is not deemed necessary in this place to enter into an elaborate description of the plan or to embody the calculations, views, and conclusions of the inventor. The plan appears to have merit, and may, perhaps, be made practically available elsewhere, especially on streams having a limited supply of water; but its application cannot be recommended for the improvement of the Des Moines rapids.

If a plain, open chute, in preference to locks, should be deemed advisable at these rapids, it is believed that there is always water enough in this part of the Mississippi to maintain navigation in such a chute more than equal to the depth on the shoals above and below the rapids; and while the plan of Mr. Livermore might work well in practice on a comparatively small scale or in a narrow channel, it contains elements which have not yet been accurately determined for a very wide channel. It has not yet been tested on a large scale, although it appears to answer in the model.

BRUNOT'S IMPROVED FLOAT GATE FOR SLUICES IN DAMS, ETC.

A working model of this gate was exhibited to the board, and its mode of operation shown by Mr. Roberts, one of the board. It is designed especially to act as a movable dam, as a regular and convenient sluice-gate on a large scale. It consists of a hallow water-tight gate, of wood or iron, held by a hinge extending across the sluice-way or opening in a dam, with side-valve gates above and below the gate for admitting and discharging water from the upper level into a recess under the gate, which, when the upper valve is open and the lower valve closed, has the pressure due to the difference of level. The hollow gate having considerable flotative power, correspondent with its dimensions, remains up in an inclined position, forming a dam, over which the water may flow. When it is desired to lower the gate to its horizontal position, water is let into the gate itself by another valve, which immediately descends by its own weight, leaving a clear sluice-way for the water; for the sluice in a dam can be so arranged as to be in part self-acting, by means of an open vertical pipe on one end in the abutment, having its mouth level with the height of water at which it may be desired to allow the gate to fall. When the pool rises to that height the water flows down the pipe and fills the gate, which then falls to its horizontal position, when vessels, rafts, &c., may pass over it.

When the stream falls the gate is raised by being emptied, the water running into the lower level, and the emptying valve is then closed, when the gate immediately rises to its inclined position and again becomes a dam, over which the water may flow without depressing it.

This gate works well in the model, and it may be worth a trial on a large scale.

Now that the construction of very large locks for ships and steamboat canals is becoming more general, it is desirable that the best plans for the construction and working of large gates should be adopted, and it might be economical for the government to institute a thorough investigation of the merits of different methods of making and operating very large locks or sluice-gates.

It is not deemed strictly within the province of the board to offer any formal recommendation on this subject, but it seems proper thus briefly to bring it to the notice of the department for consideration.

For locks eighty feet wide, having lifts of ten or twelve feet, the ordinary mitre gates would be about forty-three feet long by twenty-four to twenty-six feet high, forming a large structure, which should be strong enough to sustain the pressure of twelve feet head on a width of over forty feet. These may be built of either wood or iron—wooden gates being much cheaper in first cost.

It is possible that hollow water-tight wooden or iron mitre gates may be advantageously substituted for the solid gate, and that the ordinary plan of filling and emptying large locks may be advisable.

In case of the construction of large locks at the Des Moines rapids it might serve a useful purpose to authorize the engineer in charge to thoroughly investigate this matter by experiment, if necessary, on some sufficient scale, to obtain good practical results. The cost of this would be quite trifling and insignificant compared with the possible advantage which might accrue to the public.

As there is always a large surplus of water for canal purposes, it appears to be a favorable place for testing plans for rapidly filling and emptying large locks by the power of the water itself. It is possible that a safe, convenient, and reliable arrangement may be devised which would dispense with half of the men needed to work large gates on the old plan.

The following is a tabular statement of the estimated cost of each plan of improvement herein discussed:

1st. Improvement of the natural channel by excavation:	
200 feet wide and 4 feet deep	$2,647,785
300 feet wide and 4 feet deep	3,648,362
200 feet wide and 5 feet deep	3,504,182
300 feet wide and 5 feet deep	5,034,350
2d. The plan of dams entirely across the river, locks and chutes	2,460,091
3d. Plan proposed by Mr. Edmunds, viz: a sluice navigation entirely	1,926,720
4th. Plan of an excavated side channel on the Iowa side:	
200 feet wide and 4 feet deep	2,752,933
300 feet wide and 4 feet deep	3,503,910
200 feet wide and 5 feet deep	3,317,874
300 feet wide and 5 feet deep	4,661,910

5th. Plan of canal on the Iowa side from Nashville to Keokuk, 300 feet wide in embankment, and 250 feet wide in excavation, and 5 feet deep, in connection with channel and pier at Upper chain, $2,530,000.

6th. Plan of a canal on the Illinois side from Edmunds's warehouse to the Hamilton Ferry dike, 300 feet wide in embankment, and 250 feet wide in excavation, and 5 feet deep, in connection with channels and pier at Upper chain, and excavated channel at Nashville crossing, $3,271,430.

A general plan and profile of the rapids, embracing a plan of the canal and locks proposed under the direction of Brevet Major General J. H. Wilson, are submitted herewith to the Chief of Engineers.

The board having already submitted their conclusions, based upon the facts set forth herein, append hereto the same, for the purpose of completing this record as follows:

The board of engineers, convened by Engineer Orders Nos. 18 and 20, March 22, and March 26, 1867, having met at Keokuk, Iowa, on the 15th of April, and adjourned to this place on the 30th of April, beg leave to submit the following conclusions and recommendations in regard to the improvement of the Des Moines rapids of the Mississppi river:

1st. After a careful examination and consideration of all the plans, profiles, and river soundings, and of the calculations and views of the engineer and his assistant, an inspection of the ground on both sides of the river from a point above Montrose and Nauvoo to a point opposite the mouth of the Des Moines river, in the town of Warsaw, and a study of all the plans proposed, it is the unanimous opinion of this board that the general plan of a canal and locks submitted to the engineer department by Brevet Major General J. H. Wilson, dated January 1, 1867, and approved by Brevet Major General A. A. Humphreys, Chief of Engineers United States army, in his report of February 5, 1867, to the Secretary of War, is the best for permanently improving the navigation of the Des Moines rapids of the Mississippi river, namely, a canal along the Iowa shore from a point near the present site of the Keokuk indicator, at the city of Keokuk, to a point just below the village of Nashville, seven and six-tenths miles long.

2d. That, taking the gauge of extreme low water at or near Montrose as a guide, the canal bottom at the upper end of the proposed canal at Nashville and the level of the top of the mitre sills at the guard-lock should be fixed at five feet below such low water at the guard-lock, and that the lower mitre sill of the outlet lock at Keokuk be fixed at five feet below the low water of 1864 at that point, as referred to in the alternate suggested in General Wilson's report.

That the canal, and the middle and lower locks, be arranged for eight feet depth of water when the river rises three feet above extreme low water.

That the size of the lock chambers shall remain as given in General Wilson's report, namely, 350 feet between the quoins and 80 feet wide at top.

That the thickness of the lock walls as planned is abundant for any pressure that can come against them; and it is suggested that, in the final arrangement of the details, the engineer in charge should be authorized to make such reduction in thickness for economy as he may deem safe.

That the reverse gates proposed at the outlet lock are unnecessary, and may be economically dispensed with.

3d. That the final width of the canal be established at not less than 300 feet throughout, both in excavation and embankment, but in excavation at the time of construction it may be reduced to 250 feet without material disadvantage.

That the top of the embankment be fixed at two feet above the flow of 1851, at ten feet width, with side slopes not less than one and one-fourth and not more than one and a half base to one vertical, as the judgment of the engineer may determine.

That, if it be found economical in the progress of the work, the thickness of the ripraps may be reduced from the thickness suggested in the plan submitted by General Wilson, provided that it be not less than two feet, and that the ripraps or slope wall on the canal side of the embankment be raised only to the height of twelve feet above canal bottom, or four feet above the highest water in the canal, and that the residue of the inside slope and the top of the embankment, being above all floods, be sowed with grass or sodded, or covered with a thin coating of stone, as the engineer in charge may determine.

4th. In the report of General Wilson respecting the improvement of channel above Nashville, provision is made for the excavation of a considerable quantity of rock under water.

It is recommended that the engineer in charge be authorized carefully to investigate this part of the stream with a view to an artificial increase of the depth of water above the guard-lock, and with a view, also, of dispensing with such portion of said rock excavation under water as may be found practicable, the final arrangement to be determined by him, subject to the approval of the engineer department.

5th. If the general plan of the canal, with modification as herein recommended, should meet the approval of the Secretary of War, it is respectfully suggested that all the details and matters not specifically fixed in this report may be left to be arranged by the engineer in charge upon surveys, reports, &c., approved by the engineer department.

[Preliminary estimate omitted. For detailed estimate see p. 304.]

That the work necessary to carry into effect the plan herein recommended should be put under contract between Keokuk and Nashville without delay, and pushed vigorously to completion, so that the improvements of the rapids may be made available for commerce and navigation as soon as possible.

The important question submitted to the board has occupied their undivided attention for several weeks, during which numerous points of interest have been discussed, and many views presented and considered.

Some time must elapse before a complete report can be drawn up embodying the views and opinions of the board upon the several plans which have been considered. Meanwhile, pressing business demands the immediate personal attention of the members of the board at their respective headquarters.

Under these circumstances, it is the opinion of the board that they will best subserve the public interest by adjourning, to meet again at this place on the call of the president of the board, for the purpose of adopting the final report of proceedings.

During this interval it is understood that General Wilson, the member in charge of the works, will cause to be prepared a map on a small scale, for convenient reference, showing the ground, river bed, and such lines as will aid in exhibiting and explaining the plans of improvement which have been investigated, with the location of the canal on the Iowa side, the profiles representing the canal levels and locks, the excavation and the top of the embankment two feet above high water of 1851, also showing the line of low water of 1864 and the line of high water of April, 1867, being a copy on a reduced scale of the maps, charts, and profiles already prepared by General Wilson, showing the modifications indicated in the proceedings of the board.

J. N. MACOMB,
Colonel Engineers, Bvt. Col. U. S. A., President of the Board.
J. H. WILSON,
Lieutenant Colonel Thirty-fifth Inf., Bvt. Maj. Gen. U. S. A.
G. K. WARREN,
Bvt. Maj. Gen. U. S. A., Major Engineers.
W. MILNOR ROBERTS,
Supt. Engr. Ohio River Improvement, U. S. Civil Engineers.
PETER C. HAINS,
Captain Engineers, Bvt. Lt. Col. U. S. A., Recorder.

ABSTRACT OF PROPOSALS

FOR THE

IMPROVEMENT OF THE DES MOINES RAPIDS

OF THE

MISSISSIPPI RIVER.

E 4.—*Abstract of proposals received at the United States engineer's office at*
sippi river, at a letting

Items.	Quantities	Proposal No. 1.		Proposal No. 2.		Proposal No. 3.	
		[a] J. J. Dull, Harrisburg, Pa.		Charles H. Sherrill, New York city.		Wm. Rankin & Co., Rochester, N. Y.	
		Price.	Amount.	Price.	Amount.	Price.	Amount.
	Cubic yds.						
Grubbing and clearing			$5,000		$15,000 00		$2,800
Bailing and draining			5,000		30,000 00		46 000
Excavation of earth	315,000	$0 50	157,500	$0 43	135,450 00	$0 38	119,700
Excavation of rock	161,440	3 75	605,400	2 23	360,011 20	1 95	314,808
Loose stone in riprap wall	88,000	1 20	105,600	2 10	184,800 00	1 55	136,400
Embankment	651,500	60	390,900	47	306,205 00	50	325,750
Lining	10,000	60	6,000	58	5,800 00	65	6,500
Puddling	50,000	22	11,000	27	13,500 00	35	18,500
Slope-wall	500					2 00	1,000
Vertical wall in cement	1,000					5 00	5,000
Vertical wall laid dry	500					3 90	1,950
Concrete masonry	200					6 25	1,250
Changing line of railroad	Miles, 3	20,000	60,000	2,500	7,500 00	7,800	23,400
Changing line of public road	Rods, 960		3,000	8 00	7,680 00	4 00	3,840
Total			1,349,400		1,065,946 20		1,006,898

Items.	Quantities	Proposal No. 10.		Proposal No. 11.		Proposal No. 12.	
		[a] James Fenlon, Latrobe, Pa; Robert Swan, Pittsburg, Pa.; Philip Collins, Ebensburg, Pa.; Geo. Murray, Davenport, Iowa.		[c] Thomas J. Power, Rochester, Pa.		[d] D. Hemkins, Galena, Ill.; E. A. Collins, Davenport, Iowa.	
		Price.	Amount.	Price.	Amount.	Price.	Amount.
	Cubic yds.						
Grubbing and clearing			$2,750		$10,000 00		$2,500
Bailing and draining			40,000		60,000 00	$25,000 per mile	37,500
Excavation of earth	315,000	$0 85	267,750	$0 50	157,500 00	$0 48	151,200
Excavation of rock	161,440	3 00	484,320	4 00	645,760 00	2 30	371,312
Loose stone in riprap wall	88,000	1 25	110,000	1 50	132,000 00	1 80	158,400
Embankment	651,000	60	390,900	70	465,050 00	50	325,750
Lining	10,000	50	5,000	1 50	15,000 00	55	5,500
Puddling	50,000	40	20,000	50	25,000 00	20	10,000
Slope-wall	500	7 00	3,500	5 00	2,500 00	2 25	1,125
Vertical wall in cement	1,000	10 00	10,000	7 00	7,000 00	8 00	8,000
Vertical wall dry laid	500	7 00	3,500	5 00	2,500 00	6 00	3,000
Concrete masonry	200	10 00	2,000	6 00	1,200 00	4 00	800
Changing line of railroad	Miles, 3	800 00	8,000	500 00	1,500 00	2,700	8,100
Changing line of public road	Rods, 960	2 00	1,900	3 00	2,880 00	4 00	3,840
Total			1,349,640		1,518,890 00		1,087,027

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[a] Guarantee not in duplicate.

[b] For earth hauled more than 700 feet, one-half of one cent per yard for each 100 feet in excess. For all rock material hauled more than 700 feet, three-quarters of one cent per cubic yard for each 100 feet so delivered in excess. To work at all stages of water not exceeding four feet above low-water mark of 1864, or at any stage when the work is all out of water.

[c] Not in duplicate.

Davenport, Iowa, for the improvement of the Des Moines rapids of the Missis-held September 4, 1867.

Proposal No. 4.		Proposal No. 5.		Proposal No. 6.		Proposal No. 7.		Proposal No. 9.	
Charles G. Case & Co., Fulton, N. Y.		*b* Franklin Smith & Co., Cordova, Ill.		James Freeland, E. D. Smith, Millersburg, Pa.		*c* John S. Wolf, S. D. Carpenter, Ottumwa, Wis.		J. D. Dolan & Co., Milwaukee, Wis.	
Price.	Amount.	Price.	Amount.	Price.	Amount.	Price.	Amount.	Price.	Amount.
....	$3,000	....	$4,500	....	$2,500	Acres, 50	....	....	$1,700
....	10,000	$32,500 per mile	48,750	....	45,000	....	$50,000	$25,000 per mile	37,250
$0 60	189,000	$0 48	151,200	$0 50	157,500	$0 45	141,750	$0 35	110,250
2 50	403,600	2 50	403 600	2 20	355,168	3 90	629,616	1 75	282 520
2 00	176,000	1 50	132,000	2 20	193,600	3 50	308,000	1 45	127,600
35	228,025	65	423,475	65	423,475	84	547,260	55	358 325
1 00	10,000	80	8,000	90	9,000	90	9,000	21	2,100
25	12,500	32	16,000	1 50	75,000	1 75	87,500	....	....
3 00	1,500	5 00	2,500	5 00	2,500	4 50	2,250	1 69	845
6 50	6,500	12 00	12,000	9 00	9,000	12 50	12,500	4 87	4,870
5 00	2,500	8 00	4,000	8 00	4,000	8 00	4,000	3 25	1,625
6 00	1,200	12 00	2,400	6 00	1,200	10 00	2,000	5 00	1,000
3,000	9,000	1,000	3,000	8,000	24,000	800 00	2,400	1,200	3,600
4 00	3,840	4 00	3,840	5 00	4,800	1 00	960	2 00	2,700
....	1,056,665	....	1,215,265	....	1,306,743	....	1,797,236	....	934,385

Proposal No. 13.		Proposal No. 14.		Proposal No. 15.		Proposal No. 16.		Proposal No. 17.	
d Geo. M. Lanman, J. V. Criswell, E. J. Lanman, William Karns, Wm. Behm, Reading, Pa.		*e* Campbell & Clinton, Albany, N. Y.		*f* Alexander Graham, Whitewater, Wis.		*c* Jas. B. Parkins & Co., Madison, Wis.		*g* E. P. Reynolds, Thos. Saulpaugh, L. E. Saulpaugh, Thomas J. Buford, Rock Island, Ill.	
Price.	Amount.	Price.	Amount.	Price.	Amount.	Price.	Amount.	Price.	Amount.
....	$3,500	....	$500	....	$35,000	Pr. mile, $400	$3,000	....	$2,000
....	22,000	$25,000 per mile.	37,500	....	50,000	$33,000 per mile.	49,500	$25,000 per mile.	37,500
$0 59	185,850	$0 70	220,500	$0 70	220,500	$0 60	189,000	$0 45	141,750
3 30	532,752	5 00	807,200	1 85	298,664	1 90	306,736	2 25	363,240
2 00	176,000	5 00	440,000	2 00	176,000	1 85	162,800	1 00	88,000
25	162,875	98	638,470	85	553,775	52	338,780	48	312,720
62	6,200	1 25	12,500	90	9,000	1 00	10,000	60	6,000
35	17,500	60	30,000	30	15,000	1 50	75,000	20	10,000
4 00	2,000	4 00	2,000	2 50	1,250	1 90	950	1 50	750
9 00	9,000	6 00	6,000	6 00	6,000	7 00	7,000	6 00	6,000
6 00	3,000	4 00	2,000	5 00	2,500	5 50	2,750	5 00	2,500
10 00	2,000	7 00	1,400	10 00	2,000	12 00	2,400	5 00	1,000
1,200	3,600	1,250	3,750	1,000	3,000	1,000	3,000	1,200	3,600
600 per	mile, 1,800	2 00	1,920	4 00	3,840	1 00	960	940 per	mile, 2,820
....	1,128,077	....	2,203,740	....	1,376,529	....	1,151,876	....	997,880

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d If borrowed material is to be furnished, $10,000 in addition.

e The above bid for embankment is with the understanding that land for borrow-pits will be furnished within a reasonable distance, or will furnish land at an addition of ten cents per cubic yard for the embankment.

f Ten per cent. will be added to the embankment if I furnish the materials. (Not in duplicate.)

g Will furnish the borrowed material for an addition of two cents per cubic yard.

Abstract of proposals for the improvement of the Des Moines rapids of

Items.	Quantities.	Proposal No. 18.		Proposal No. 19.	
		Wm. Henegen & Son, Mt. Vernon, Ohio.		William Budd, W. H. Decker, J. M. Ault, S. K. Concanon, Thos. M. Hacket, Adolph Knipper, St. Louis, Missouri.	
		Price.	Amount.	Price.	Amount.
	Cubic yards.				
Grubbing and clearing			$200		$1, 500
Bailing and draining			2, 500		43, 000
Excavation of earth	315, 000	$0 33	103, 950	$0 65	204, 750
Excavation of rock	164, 440	1 35	217, 944	2 25	363, 240
Loose stone in riprap wall	88, 000	1 35	118, 800	2 25	198, 000
Embankment	651, 000	37	241, 055	60	390 900
Lining	10, 000	40	4, 000	1 50	15, 000
Puddling	50, 000	20	10, 000	50	25, 000
Slope-wall	500	2 00	1, 000	8 00	4, 000
Vertical wall in cement	1, 000	5 25	5, 250	10 00	10, 000
Vertical wall laid dry	500	4 50	2, 250	6 00	3, 000
Concrete masonry	200	5 25	1, 050	8 00	1, 600
Changing line of railroad	Miles, 3	500 00	1, 500		8, 500
Changing line of public road	Rods, 960	2 25	2, 160		4, 000
Total			711, 659		1, 272, 490

Items.	Quantities.	Proposal No. 24.	
		Wm. W. Wright, Geneva, New York.	
		Price.	Amount.
	Cubic yards.		
Grubbing and clearing			$3, 000
Bailing and draining			20, 000
Excavation of earth	315, 000	$0 62	195, 300
Excavation of rock	161, 440	3 32	535, 980
Loose stone in riprap wall	88, 000	2 00	176, 000
Embankment	651, 500	22	143, 330
Lining	10, 000	60	6, 000
Puddling	50, 000	35	17, 500
Slope-wall	500	4 50	2, 250
Vertical wall in cement	1, 000	9 00	9, 000
Vertical wall laid dry	500	7 00	3, 500
Concrete masonry	200	10 50	2, 100
Changing line of railroad	Miles, 3	1, 000	3, 000
Changing line of public road	Rods, 960	Mile, 600	1, 800
Total			1, 118, 760

I certify that the foregoing is a true abstract of the original bids received by me for this work.

UNITED STATES ENGINEER'S OFFICE,
Davenport, Iowa, September 10, 1867.

the Mississippi river, at a letting held September 4, 1867—Continued.

Proposal No. 20.		Proposal No. 21.		Proposal No. 22.		Proposal No. 23.	
Wm. Armstrong & Co., Philadelphia, Pa.		O. H. P. Scott, Farmington, Iowa.		Fox & Howard, Chicago, Illinois.		*a* Ledlie, Corse & Co., Chicago, Ill.	
Price.	Amount.	Price.	Amount.	Price.	Amount.	Price.	Amount.
Per rod, $4 00	$9,600	....	$3,000	....	$1,500	Per mile, $400	$3,000
25,000 per mile.	37,500	$30,000 per mile.	45,000	....	39,000	19,200 per mile.	28,800
$0 35	110,250	$0 45	141,750	$0 47	148,050	$0 65	204,750
1 95	314,808	2 95	476,248	2 55	411,672	2 75	435,888
1 49	131,120	1 75	154,000	1 50	132,000	1 45	127,600
45	293,175	55	358,325	58	377,870	40	260,000
65	6,500	75	7,500	58	5,800	95	9,500
20	10,000	25	12,500	25	12,500	24	12,000
2 25	1,125	3 00	1,500	4 50	2,250	2 90	1,450
1 25	1,250	10 00	10,000	7 00	7,000	6 90	6,900
1 00	500	6 00	3,000	6 75	3,375	5 90	2,950
2 50	500	12 00	2,400	7 50	1,500	7 90	1,580
3,000	9,000	4,000	12,000	1,700	5,100	Rod, 20 00	19,200
4 00	3,840	3 15	3,024	3 25	3,120	3 00	2,880
....	929,168	....	1,230,247	....	1,150,737	....	1,117,098

Proposal No. 25.		Proposal No. 26.		Proposal No. 27.		Proposal No. 28.	
L. Stanton, Wm. Irvin, Freeport, Ill.		John Ross, Brookfield, Missouri.		Peter D. Tobio, Utica, New York.		Walker, Lee & Co., Chicago, Illinois.	
Price.	Amount.	Price.	Amount.	Price.	Amount.	Price.	Amount.
....	$3,500	....	$1,000	....	$100	....	$1,000 00
....	45,000	....	28,000	....	30,000	....	33,666 00
$0 45	141,750	$0 57	179,550	$0 25	78,750	$0 53	166,950 00
1 95	314,808	3 40	548,896	2 00	322,880	2 52	406,828 80
1 50	132,000	1 50	132,000	4 00	352,000	1 40	123,200 00
50	325,750	67	436,505	25	162,875	70	456,050 00
60	6,000	1 00	10,000	40	4,000	75	7,500 00
30	15,000	26	13,000	10 00	5,000	25	12,500 00
....	....	4 00	2,000	6 00	3,000	4 00	2,000 00
....	....	6 00	6,000	9 50	9,500	6 50	6,500 00
....	....	5 00	2,500	6 00	3,000	6 00	3,000 00
....	....	6 00	1,200	10 00	2,000	7 00	1,400 00
500 00	1,500	3,000	9,000	1,000	3,000	1,500	4,500 00
Rod, 4 00	3,840	1 25	1,200	3 00	2,880	3 00	2,880 00
....	989,148	....	1,370,851	....	978,985	....	1,227,974 80

a The above bid is for the whole work.

J. H. WILSON,
Lieut. Colonel 35th Infantry, Brevet Major General U. S. A.

E 5.

ANNUAL REPORT OF COLONEL P. C. HAINS ON THE IMPROVEMENT OF THE ROCK ISLAND RAPIDS OF THE MISSISSIPPI RIVER.

DAVENPORT, IOWA,
September 10, 1867.

GENERAL: In obedience to your verbal orders, I have the honor to submit the following report of operations connected with the improvement of the navigation of the Mississippi river at Rock Island rapids:

It will be remembered that, during the last season, when the survey was made for determining the best place of improvement at these rapids, the limited time at our disposal necessarily prevented our making as thorough an examination of the bed of the river as was desired. I have thus far this season endeavored to leave nothing wanting in the way of useful information touching the plan of improvement that was adopted. For this purpose it became necessary to add many more soundings to the number taken last year, and accordingly a party has been organized and is now engaged on this work under my direction.

In the early part of May tide-gauges were established at various points along the rapids and connected with our levels, for the purpose of ascertaining accurately the relation between the depths of water on the different chains, and the slope of the water surface from the head to the foot of the rapids for all stages of the river. Observations are made twice a day at each gauge, viz: at 6 a. m. and 6 p. m., and the result recorded. The records up to the present time include periods when the river was both rising and falling. These records have not yet been plotted, however.

Though the river here has not been excessively high, or, in other words, though there has not been what is properly termed a flood, the average height for the season has been thus far much greater that usual. During last month (August) the river was much higher than it has been known to be at that season for many years.

I enclose herewith a tracing of the curves, showing the oscillations of the river at the Chicago and Rock Island railroad bridge, near the foot of the rapids. The curves run through the whole period of the last seven years, with the exception of a small portion of 1864, during the time the bridge was destroyed. They are plotted by taking one co-ordinate for time, and the other for the stage of the river above an assumed zero. This was established at what was supposed to be the lowest known stage, viz: that of September 2, 1864. This is also the zero of the gauge of the bridge. It will be seen, however, that in November of that year the river fell two inches below that point. The curves are started at a common origin and made of different colors, so that they can all be seen at one time and comparisons easily made.

Some very instructing features connected with the rise and fall of the water in the river may be noticed by examining this diagram, which will serve as a tolerably good guide to predict what may be the probable stage of the water at certain periods with something like accuracy, thereby affording the means of judging what would be the probable length of time that work on the improvement of the navigation could be prosecuted. For instance, it will be seen that during the months of February and March the river is almost invariably subject to great and sudden rises, sometimes as much as five or six feet in twenty-four hours. They do not, however, last long, being generally caused by what are termed "ice gorges," which occur nearly every season on the breaking up of the ice in the river and piling up below the rapids like a dam, causing for the time a partial stoppage of the flow of water. These "gorges" sometimes occur in the winter, when the river becomes filled with floating ice and is retarded or driven on either shore by a strong adverse wind. Every year, except 1861, it will be observed there was a rise, more or less great, that occurred about the first of May. In 1861 this rise came later than usual, but it will be seen that it always comes. This is what is commonly called the "June rise," due to the thawing of the ice and snow in the region about the sources of the river. At this point it would doubtless be more properly termed the "May rise." In 1864 this was not very great; but it will be remembered this was one of the most remarkably dry seasons known in many years.

The small variations as shown by these curves, either increasing or decreasing the height, are generally due to the effects of wind and rain. The river here is also somewhat affected by the stage of Rock river, which empties into the Mississippi about four miles below. Variations due to wind or rain are not generally of long duration or very great extent, seldom exceeding a few inches.

The low stages commence generally about the 1st of July; the river then falls gradually somewhat lower and continues low until about the middle of December.

With this information before us, it is no very difficult matter to estimate with tolerable accuracy the length of time that can be generally relied on for work on the improvement of the navigation.

The present season has been one of unusual high water, and has greatly retarded operations on the work, the short working season that now remains rendering the use of coffer-dams for excavating the rock a hazardous undertaking. Notwithstanding this, timbers have been framed and every preparation made to commence a coffer-dam on "Duck creek chain" at once. This will be used on the next reef below the uppermost one of this chain. At the latter two chisels have been put in operation. They are like those formerly used by Major Floyd with apparent success on the Lower rapids, but it is found that the rock at this place is extremely hard, and very slow progress is made. A fair opportunity to test their ability has not yet been afforded, however. They have been at work only two or three days, and during this time much delay has been caused by breaking and readjusting parts of the machinery, which were made too light for the enormously heavy chisels, weighing nearly 8,000 pounds. The first part of the work is necessarily more difficult owing to the trouble of getting a proper face upon the ledge required to be removed.

The channel at "Duck creek" is one of the most tortuous and difficult of navigation of any on these rapids. The improvement that is to be made this season will give a good straight channel throughout almost the entire length of the "chain." As soon as the work at "Duck creek" is accomplished, I would propose that our efforts be next directed to Sycamore and Campbell's chains.

About 8,000 cubic yards should be taken out from Sycamore and Crab island, about 1,500 yards from Campbell's chain, and the balance of the present appropriation at Smith's chain. In my report of last year I estimated the amount required to complete the work at $813,601 80. I have no changes to make in that estimate. The amount that can be profitably expended during the next fiscal year will be determined by circumstances. There should be at least $500,000 at the disposal of the engineer, so that in case of a favorable season, the greater part of the entire work could be finished promptly.

Very respectfully, your obedient servant,

PETER C. HAINS,
Captain Engineers, Brevet Lieutenant Colonel, U. S. A.

Brevet Major General J. H. WILSON,
Lieutenant Colonel 35th Infantry.

E 6.

Abstract of proposals for removing the rock and other obstructions from the bed of the Mississippi river, at the Rock Island rapids, at a letting held in the United States engineer's office, Davenport, Iowa, June 5, 1867.

No.	Names of bidders.	Conditions.	Price per cubic y'd.
1	E. R. Blackwell, New York, N. Y....	2,000 cubic yards per month, at.	$12 25
		3,000.....do.......... do	13 00
		4,000.....do.......... do	15 00
		5,000.....do.......... do	17 50
2	Jason C. Osgood, Troy, N. Y	To remove all the rock at the rate of.	15 00
	Damon Wells, Chittenango, N. Y	To do the work by means of chiselling, and to remove at least 1,000 cubic yards per month during 1867, when the river is not more than 4 feet above the low water of 1864, or ice in the river to prevent working, and during all the working months of 1868, 2,000 cubic yards per month until the whole amount of the present appropriation is expended.	
3	John F. Hosch, Mohawk, N. Y	To remove all the rock agreeably to the terms of advertisement, at the rate of.	17 75
4	W. Hunkins, Galena, Ill.; H. M. Mandeville, St. Louis, Mo.; Richard Smith, St. Louis, Mo.	To remove all the rock agreeably to the terms of the advertisement, at the rate of.	*14 00
5	Charles G. Case & Co., Fulton, N. Y. †.	To remove the rock at Smith's chain, for.	‡14 00
		To remove the rock at Sycamore chain, for.	13 00
		To remove the rock at Crab island, for.	13 00
		To remove the rock at St. Louis chain, for.	13 00
		To remove the rock at Campbell's chain, for.	15 00
		To remove the rock from Campbell's chain to Duck Creek chain, for.	13 00
		To remove the rock at Duck Creek chain, for.	10 00
		To remove the rock at Lower chain, for.	10 00
		To remove the rock at Moline chain, for.	10 00
6	William Irvin, Freeport, Ill.; Lodawick Stanton, Freeport, Ill.	To remove all the rock agreeably to the terms of the advertisement, at the rate of.	16 00
7	George Murray, Davenport, Iowa ...	To remove the obstructions at the rate of.	18 95

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[*] This proposal was not in duplicate.

[†] Contract awarded June 12, signed June 28.

[‡] This bid being at an average price of $12 71 per cubic yard less than any other, the parties being recommended by parties known to this office as responsible and thoroughly competent to perform what they undertake, and the contemplated contract requiring the work to be done at such point or points as may be designated by the engineer in charge of the work, it is to the interest of the government that they should be declared the successful bidders and be required to enter into contract without delay.

Abstract of proposals for removing rock, &c.—Continued.

No.	Names of bidders.	Conditions.	Price per cubic y'd.
	George H. French, Davenport, Iowa; James E. Abbott, Davenport, Iowa.	To build all coffer-dams to resist a rise, equal to 4 feet above the low water of 1864, and to do all other excavation, except that done by coffer-dams at a stage of water not exceeding 3 feet above the low water of 1864.	
8	Elisha Reynolds, Rock Island, Ill.; Thomas Saulpaugh, Rock Island, Ill.; Louis E. Saulpaugh, Rock Island, Ill.; Thomas J. Buford, Rock Island, Ill.	To remove the rock agreeably to the terms of the advertisement, at the rate of.	*$12 80

* This bid is seventy-one cents per cubic yard higher than the average of Case & Co. If the work should be done from the upper end, the appropriation would go further in the hands of Reynolds, Saulpaugh, Saulpaugh & Buford, than in those of Case & Co., but the interest of the government, under the circumstances, require that the work should begin at the lower end, and that Case & Co. should have it.

I certify that the foregoing is a true abstract of the original bids put in by the bidders for this work.

J. H. WILSON,
Lieutenant Colonel 35th Infantry, Brevet Major General U. S. A.

UNITED STATES ENGINEER'S OFFICE,
Davenport, Iowa, September 10, 1867.

E 7.

Abstract of contracts for the improvement of the Mississippi river at the Rock Island rapids.

No.	Name of contractors.	For what purpose.	Price per cubic y'd.
1	Charles G. Case, F. D. Van Wanenew, Fulton, N. Y.	Excavating and removing rock from the bed of the Mississippi river at—	
		Smith's chain	$14 00
		Sycamore chain	13 00
		Crab island	13 00
		St. Louis chain	13 00
		Campbell's chain	15 00
		From Campbell's chain to Duck Creek chain	13 00
		At Duck creek	10 00
		At Moline chain	10 00
		At Lower chain	10 00

REMARKS.—The prices for excavating and removing the rock are to be in full compensation for all coffer-dams, bailing, machinery, boats, and materials of every sort required, and all labor necessary to complete, in all respects, the work as provided for in the contract, and to remove at least 5,000 cubic yards per month, unless prevented by some cause beyond their control.

J. H. WILSON,
Lieutenant Colonel 35th Infantry, Brevet Major General U. S. A.

UNITED STATES ENGINEER'S OFFICE,
Davenport, Iowa, September 10, 1867.

APPENDIX F.

NEW ORLEANS, LOUISIANA, *September* 12, 1867.

GENERAL: In compliance with engineer department circular No. 11, dated June 10, 1867, I have the honor to submit the following report of progress of all works of river and harbor improvements and surveys in my charge since November 15, 1866, the date of my last annual report:

IMPROVEMENT OF THE MOUTH OF THE MISSISSIPPI RIVER.

The contractor, Mr. Horace Tyler, who, according to contract, was to have formed a channel across the Southwest Pass bar, of 18 feet depth and 200 feet width, by the 23d of January, 1867, and maintain the same three months, failed to complete his dredge-boat, the Wiggins, before the latter part of March, 1867. He commenced work at the bar March 19, 1867. The time for completing the formation of the channel was, on his application, repeatedly extended till the latter part of May, 1867, when it appearing that, owing to the inadequate and imperfect character of his boat and machinery, he was likely to accomplish no results, his contract was annulled. In view of the additional appropriation of $200,000, which was to become available on the 1st of July, 1867, I deemed it important to ascertain definitely which of the several passes was at the present period most susceptible of improvement by dredging or excavating. For this purpose authority was obtained from the engineer department to make surveys of Southwest Pass and Pass à Loutre, and the Coast Survey office kindly ordered two of its parties to report to me. The surveys were made during the spring months of the year, and consisted mainly in ascertaining the soundings, the extent of the bars along the mid-channel line, the positions and degree of straightness of the latter, and the character of the surfaces and sub-strata of the bars. Since July 3, 1867, I have been engaged in perfecting models, drawings, and specifications of a dredge-boat, authorized by a joint resolution of Congress, approved March 29, 1867.

On the 26th ultimo I commenced advertising for proposals for constructing and delivering the same. By the terms of the advertisements, the proposals were to be opened on the 10th instant, and the contract executed on the 14th instant. The hour of opening proposals has by further notice been postponed to 12 m. to-morrow. The following information relates to points specially referred to in the circular:

1. As a result of the survey, Pass à Loutre was selected for improvement under the appropriation for the current fiscal year, and the unexpended balance of the one for last year, amounting together to about $273,000. The plan adopted is that of excavating and stirring or harrowing up the minute alluvial material, forming mainly the bars by deposit from the heavily-laden waters of the river, by means of double-ender dredge-boats fitted with an excavating screw 14 feet in diameter, of four blades, at one end, (similar and similarly mounted to the ordinary screw-propeller,) turning by means of a double engine at the rate of sixty revolutions per minute, and reaching two feet below the under side of the keel; and an auxiliary scraper or harrow at either end. The light, and in many cases almost semi-fluid material thus again brought into a disseminated and floating condition will be gradually carried off to deep soundings by the current of the river and the tide of the gulf.

2. Owing to the character of the condition under which the bars are formed and maintained, this work is not susceptible of "entire and permanent completion." The water of the river is heavily and constantly laden with sediment, with an increasing tendency to rapid deposit on the bars the instant the channel depths are increased. After the completion of the two dredge-boats required for the work, an annual expenditure of $100,000 will be required for the constant maintenance of a 20-foot channel; of which $75,000 is estimated for removing and working expenses, and $25,000 for repairs, buoys, &c.

3. During the next fiscal year $375,000 can be profitably expended upon the work, and is absolutely essential to its success, of which amount $100,000 is estimated for running and working expenses, repairs, &c., and $275,000 for construction and delivery of the second of the two required dredge-boats. At least two dredge-boats are required for constant maintenance of a channel, since a machine of their character is liable at any time to become disabled to the extent of requiring a cessation of work for repairs, and must be docked at least once a year for general repairs and overhauling.

4 and 5. This work is located in the collection district, and near the port of New Orleans.

6. The amount of revenue collected at the port of New Orleans during the last fiscal year is five million three hundred and eighty-eight thousand three hundred dollars and sixty cents, ($5,388,300 60.)

7. During the year 3,953 vessels, with a tonnage amounting to 2,290,461 tons, were cleared from the port of New Orleans. The freights on flour and grain from St. Louis to New York via New Orleans, and from St. Louis to New York by rail, are about as follows, viz:

St. Louis to New York via New Orleans.		St. Louis to New York by rail.	
Flour	$1 20 per barrel.	Flour	$1 80 per barrel.
Wheat	0 36 per bushel.	Wheat	0 52½ per bushel.
Corn	0 35 per bushel.	Corn	0 49½ per bushel.
Oats	0 20 per bushel.	Oats	0 28 per bushel.

For further information and remarks in this connection reference is respectfully made to my annual report dated November 14, 1866.

8, 9, and 10. No proposals have been considered nor contracts executed since my report of last year.

SURVEY OF GALVESTON HARBOR WITH A VIEW OF FORMING PLANS FOR ITS PRESERVATION AND IMPROVEMENT.

Great difficulty was found in securing the services of experts competent for this survey, and some delay had occurred in efforts to this end, when, at the solicitation of the engineer department, the Coast Survey Office kindly ordered one of its parties, under command of Mr. Nes, to report to me for the execution of the survey.

In May last I ordered Lieutenant W. S. Stanton, corps of engineers, one of my assistants, to proceed to Galveston and direct the survey. The assistant of the Coast Survey did not report with his party until the 31st of that month. From the 1st until the 6th of June the party was engaged in repairing the surveying vessels and in taking in supplies. On the 6th they commenced taking soundings and making current observations in that part of the harbor west of the meridian through the eastern extremity of Bird Key; they were occupied upon this work until the 20th.

During this time 22,859 soundings, distributed over an area of fifty-two (52) square miles, were taken. Current observations were made at the points where the surveying vessel was anchored. On the 21st preparations were commenced for the survey of Red Fish bar, but were discontinued on the 24th, and the survey of the shore line of the harbor begun.

From the 25th of June to the 6th of July the party was engaged on the survey of the shore line of Pelican island and Bolivar Point, in making current observations in Galveston and Bolivar channels, and in ascertaining the character of the sub-strata of Pelican Spit.

Sickness having broken out among the officers and men, and the weather being very unfavorable for the prosecution of the work, the party was discharged on the 6th.

The charts, exhibiting the results of the survey as far as it had progressed, are now preparing at the Coast Survey Office in Washington.

As soon as a party can be had after the subsidence of the yellow fever the field work of the survey will be resumed. I anticipate that in the course of the ensuing winter I shall be able to complete the survey and prepare and submit a plan for preserving and improving the harbor.

I have in hand funds probably sufficient to complete the survey, from the appropriation for examinations and surveys on the Atlantic coast.

SURVEY OF PASS AND BAYOU MANCHAC AND AMITE RIVER, LOUISIANA, WITH A VIEW TO DETERMINING THE FEASIBILITY OF FIRST-CLASS STEAMBOAT NAVIGATION THROUGH THEM BETWEEN THE MISSISSIPPI RIVER AND LAKE PONTCHARTRAIN.

The field work of this survey was begun and completed during the months of May and June last under the superintendency of Lieutenant J. K. Hezlep, corps of engineers, one of my assistants, since deceased. The report and accompanying maps and plans are in course of preparation, and will, doubtless, be in readiness to be submitted early in December next. No funds in addition to the amount derived from the appropriation for examinations and surveys of western and northwestern rivers now in hand are required.

Very respectfully, your obedient servant,

M. D. McALESTER,
Brevet Brigadier General and Major of Engineers.

Brevet Major General A. A. HUMPHREYS,
Chief of Engineers, Washington, D. C.

F 1.

UNITED STATES ENGINEER OFFICE,
New Orleans, March 29, 1867.

GENERAL: I have the honor to acknowledge the receipt of engineer department letter of the 23d instant, notifying me of an additional appropriation of $200,000 for improving the mouth of the Mississippi, and asking information as to the success and prospects of success obtained by the present contractor, Mr. Horace Tyler, &c.

After considerable delay, due to repeated accidents to the machine during informal trials at the wharf, the ferry boat Wiggins, containing the machine designed for reducing the bar, started for the mouth of the river on the 19th instant, commanded by Captain E. L. Brady, and accompanied by Lieutenant D. W. Payne, corps of engineers, and myself. The pumps for feeding the boat's boilers got out of order several times on the way down, and the buckets of her driving wheel were found shifting, owing to the greatly increased depth to which she was settled in the water by the introduction of the dredging machine. A day at Fort Jackson was, therefore, taken for repairs, and another after arrival at the telegraph wharf at Southwest Pass. It became apparent on the way down that the Wiggins had not sufficient power to permit of her being handled easily, and to enable her to hold the conical screws in contact with any desired points of the bar, either with or against the current. Captain Brady therefore decided not to attempt work on the bar until the contractor should send a tug to assist the Wiggins.

On the 23d, however, the machine was taken to the flats, near Pilot Town, in Southwest Pass, about a mile and a half above the bar, for trial. The first trial was in six feet water, hard bottom, the Wiggins being tied to a wharf.

Whenever the conical screws came in contact with the bottom they tore it up without difficulty, and in the course of twenty to thirty minutes the water under and in immediate vicinity of the screws (their position was shifted laterally but five or six feet) was deepened from one foot to two and a half feet. For the second trial the Wiggins was cast off into eighteen feet water where the current was comparatively slight, her screws lowered to that depth, and set to work, the boat being placed and held in position by means of her own propelling power; bottom soft. The boat could no more than hold her own against the current, but she shifted position gradually in shore to fifteen feet water, the screws still turning about ten revolutions per minute, and easily clearing their way in the three feet of soft mud. The hoisting and lowering apparatus worked well, the work being done by one of the engines provided for turning the screws. The screws, with the frame in which they are mounted, were hoisted or lowered through a distance of twelve feet in eight minutes.

The conical screws are twenty feet long, five feet in diameter at their basis, and are placed so that their points come together in front of the boat's cutwater, and their bases are separated from each other so as to measure about twenty feet "from out to out." They are mounted so that their axes are horizontal, the salient angle they form being foremost. Their flanges are twelve feet wide at the base of the cones, diminishing to six inches at the points.

These trials convince me that the screws can remove whatever sedimentary portions of the bar they may be brought in actual contact with, whether they be hard or soft. The limited surfaces of the flanges, and the small velocity with which they strike the water, can insure very little, if any, work, however, (except when the bar is very soft,) from the "wash," and the effort to throw up the particles, disturbed from their beds, well into the current will doubtless be slight. It will be noted that all the dimensions adopted for the conical screws are reduced one-half (about) from those prescribed by Mr. Bishop, their inventor.

With the knowledge I have, I can as yet predict neither the success nor non-success of the contractor. The doubtful questions are: Can the machine be handled, even with the help of a tug, with sufficient facility and precision to perform the required work? To what extent will operations be hindered by accidents to which the character both of the boat and machine render them peculiarly liable? There is, moreover, the liability to shipwreck. (See my letter of 2d instant.)

I returned to this city on the 25th instant, leaving Lieutenant Payne on the spot, with orders to report to me without delay any incident relating to the success or prospect of success of the contractor's efforts. Anything of this character transpiring I will report immediately to the department. A tug, to serve constantly as tender and tow-boat for the Wiggins, started for the bar this morning.

The last extension granted the contractor expired on the 10th instant. I have decided to take no further action as to extension, awaiting the determination of the question of the contractor's success.

As to the boat designed especially for work on the tide-water bars of the Mississippi, proposed in my letter of the 2d instant, a further description of her may not be out of place at the present time. She should be a "double-ender," provided with two strong and powerfully driven screw propellers, one at each end, driven by separate engines, and with water-tight compartments or tanks, such that when empty the vessel would draw sixteen feet, (a depth of channel always possible across the bars,) and when full of water, say twenty-four feet, (a depth of channel as great as will probably be called for for many years to come.) When drawing twenty-four feet her upper or spar deck should be not more than two feet above the water, in order to bring the point of attachment of any device it might be found necessary to add in aid of the action of the propellers as near the working point on the bar as possible. The total depth of the vessel from the spar deck to the bottom of the keel would, therefore, be twenty-six feet, (about.) Her spar deck should be nearly flat, like a monitor's, and perfectly clear of all obstructions from both ends to near "midships," to facilitate the addition at any time of any device found necessary. She should have a single pilot-house midships, about or under which any structures required for quarters and other purposes could be placed. Her length and beam would be determined by the space and flotation required for her water compartments, boilers, and machinery, coal, &c. The minimum draft being sixteen feet, the screw propellers should describe circles of about that diameter. The number of blades allowed the propellers would be a matter for consultation with experts, but it is likely that four blades would be preferable. Their ends should be shaped so as most readily to cut away compacted mud. I apprehend no difficulty in mounting and shaping the rudder-posts and rudders so as to be fully able to stand any impact against sedimentary deposits of any degree of hardness, and so as not to interfere essentially with the action of the screws in cutting away such deposits. The forward rudder would, of course, be always made fast in a position parallel with the keel, (like that of a New York ferry-boat,) to be released when the engines should be reversed. The rudders would, of course, have a different shape from an ordinary ship's rudder, in order to avert damage by impact.

The vessel should be very staunch and strong.

Such is a brief outline of my plan for a dredge-boat. I would not feel competent to elaborate the details and working plans without consultation with expert ship-builders.

The screw propeller embodies whatever is valuable in the principle of Bishop's conical screws, and moreover exceeds them in efficiency to the extent of the powerful wash it exerts in immediate contact with the bar, both to displace the particles composing it and to throw them well up into the current.

On witnessing the performance of Bishop's cones, I determined that their efficiency would be as great as it is at present were the cones cut off within five feet of their bases and placed side by side, nearly in contact, in front of the bow of the boat. As at present arranged, they have a ridge between them.

I have no doubt whatever of the ability of a vessel (one or more) like the one I have described to produce and maintain the requisite depth of channel everywhere when the bar is smooth and free from mud lumps, with her screws unaided, and very little doubt of her ability to reduce even the mud lumps. One thing is certain, and that is, if the screws are sufficiently strong, and turned by engines sufficiently powerful, they will necessarily cut away whatever compacted mud they come in contact with.

During my passage up the river on the screw steamer Monterey, (25th instant,) one of the blades of her screw struck the limb of a drifting tree, (the limb being perfectly sound and eight inches in diameter,) and cut it short off as if done with a single blow of an axe, producing no injury to the propeller screw, the ship, or the machinery. The engine was not even stopped. If necessary, however, to cut away the mud lumps any device thought to be efficient for that purpose can at any time be added. Indeed, it may in any event be a question whether the plan of blasting the mud lumps, so successfully applied by Colonel Long, (see his reports,) is not the best one. The experience of Mr. Tyler, under the present contract, in regard to mud lumps may be valuable.

I am authentically informed that the propeller Matanzas, reaching the bar about eighteen months since with a greater draught than was then admissible, worked her way through, stern foremost, by means of her propeller screws, the depth of mud worked through being estimated at two to two and a half feet. Of course the ship drew more water aft than forward. *

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* Several other instances of ships making their way through the muddy deposit, stern foremost, by means of their own screws, have been indirectly reported to me.

The plan of adjusting the draught of vessels by filling and emptying their water compartments provided for that purpose, has been frequently applied successfully to vessels of war.

A dredge-boat such as the one proposed could, I presume, be constructed within three months after the completion of the working plans, at ship-yards possessing extensive resources like some existing at New York, Philadelphia, and Wilmington. Requisite skill and facilities are not to be found here nor on this coast.

I would respectfully call the attention of the department again to my remarks on the subject of width of channel, thorough and ample buoying of the same, and the necessity of the constant presence of a person properly authorized to control ship and tow-boat masters and pilots, and regulate the passage of vessels through the channel, (see my letter of 21st ultimo.)

The buoys should be ranged along either side of the channel at intervals of fifty to one hundred yards, so as to serve at night on lines say 200 feet apart, equidistant from the mid-channel line. The work of dredging could then proceed for a width of channel of 120 to 150 feet, and vessels pass through without interference with the buoys. The buoys should be placed under direction of the officer in charge of the improvement; the buoys being furnished by the light-house bureau, or purchased by himself. At present there are but five buoys in the Southwest Pass, one of which marks a wreck and another a mud lump. Buoys are placed under direction of the light-house inspector when their necessity is claimed by the pilot. As a matter of course the pilots will have no more buoys placed than are absolutely necessary to indicate the channel to themselves, in order that no vessel may enter the channel without their services.

I regard the proposition of stationing a person at the channel, with absolute control of it, *as of the first importance*, not second even to the project of deepening the channel itself. Should Pass à Loutre be finally selected for improvement, there will be scarcely any opposition to obtaining and maintaining absolute control, Southwest Pass being the one at present principally used.

In my letter of the 21st ultimo, above referred to, I stated that I believed the pilot commissioners were appointed by the governor of the State. I have since learned authentically that they are *elected by the pilots themselves*, the persons elected being themselves bar pilots, the governor merely going through the form of confirming the election.

As strange as it may appear, when the importance of the interests involved are considered, the pilot commissioners, once elected, are subject to no authority whatever.

Very respectfully, your obedient servant,

M. D. McALESTER,
Brevet Brigadier General of Engineers.

Brevet Major General A. A. HUMPHREYS,
Chief of Engineers, Washington, D. C.

F 2.

UNITED STATES ENGINEER OFFICE,
New Orleans, La., June 7, 1867.

GENERAL: In accordance with instructions contained in engineer department letter of the 13th ultimo, I transmit herewith a plan, with specifications, of a dredge-boat which, in my opinion, will accomplish the best results in opening channels across the bars at the Mississippi river mouths. I have been unable to describe more specifically many important parts of the boat in consequence of the absence in this vicinity of any person sufficiently expert in ship-building, marine architecture, and marine machinery, to be of any aid in consultation. Should the department approve the plan, I would respectfully suggest, if deemed expedient, that I be authorized to visit some point on the Atlantic seaboard, where access can be had to persons expert in planning mercantile or United States naval, sea-going steamers, with a view to fixing definitely upon the several parts of the dredge-boat, so that they shall be compatible with each other, and with maximum efficiency; and to drawing up specifications corresponding thereto, to be used in the advertisements for proposals, and in the draft of the contract for building the dredge-boat. Otherwise I would respectfully suggest that working plans and specifications, based on the outline description and specifications herewith submitted, might be advertised for, offering a premium for the one adopted.

As stated in my previous communication on the subject, I feel confident that the dredge-boat I propose will be competent to deepen and maintain the required channel by means of the propellers alone. But with a view to rendering ultimate success certain, I have so devised that the boat can at any time receive additional machinery thought competent or necessary either to accomplish or hasten the desired results. In furtherance of the view, and also for the following reasons, I have made full provision (see specifications and sketches) for the addition, at will, of scrapers to act on the bars, in conjunction with the propellers:

1. The adaptation of the boat (apertures, hawser-holes, &c., in the hull) will occasion a very insignificant outlay while she is yet in the stocks; and the scraper apparatus (see rough sketch herewith, illustrating its character) can be fabricated in this city, and attached at any time while the boat is afloat, by means of simple appliances, it being only necessary to moor her in still water.

2. We *know* that the plan of scraping is, to a certain extent at least, efficient by actual trial during a period of at least seven months of the season during which the bars constitute the greatest obstruction to navigation, (January to August, 1860; see certificates of C. H. Fuller, supervisor, &c., and approvals of Colonel Long, topographical engineers, United States agent, pp. 205 to 210, Executive Document No. 5, thirty-sixth Congress, second session, House of Representatives.) The scrapers I propose are equally efficient with the one applied by Colonel Long, (see p. 162 of document just referred to,) are much simpler in their construction and application, and far less unwieldy.

3. In passing up stream across the bar, the resistance of the current is such that the boat may be made to pass *over the bottom* slowly enough to obtain the maximum excavating effect of the propeller on the bar, without, at the same time, preventing efficient steering, or the boat being kept parallel with the current, (in this case it is the *up*-stream propeller that does the work both of propulsion and excavation.) But in passing *down* stream, across the bar, it is desirable also to get the effect of the propellers in excavating it; and as the current is three feet to four feet per second, in order to obtain "steering headway" the boat must pass so rapidly over the *bottom* as partially to neutralize that excavating effect. But the scrapers (which are attached to the *up*-stream end of the boat only, and arranged to work *down* stream, the work of propulsion being in this case done by the *down*-stream propellers) obviate this defect, aid to hold the boat parallel to the current, and the propeller to its work of excavating. Moreover, in moving down stream, there will be a surplus of power which can, better than not, be utilized for working scrapers. As before stated, however, any other preferable device which may occur or be presented may, at any time, be attached when the necessity becomes apparent.

In devising the dredge-boat, I have constantly kept in view the important consideration of ample power combined with thorough staunchness; fully impressed with the idea that no cheap device, however ingenious, could be invented, such that the immense deposits obstructing the bar channels could be disposed of as if by something like magic; and fully believing that, in order to accomplish the object, a certain sum of money must be expended, a certain amount of steam generated, and a certain quantity of actual work done.

I am, moreover, still of the opinion (see my letter on this subject, June 25, 1866) that continuity of work is a consideration of great importance, whatever plan may be used, in order that the deposits, once displaced or floated up, may be floated or washed beyond the limits of the bar before being redeposited. Hence the "double-ender," obviating the loss of time occasioned in turning a "single-ender," at each change of direction across the bar.

I am aware that the cost of the boat will be considerable; but that it can be built and a channel of twenty feet maintained for a year within the amounts now appropriated, I have no doubt, and the boat will be available for operations under subsequent appropriations.

It may be proper to note that some time last February I intimated my plan of combining the ordinary ship's propeller with the adjustment of a boat's draught of water by means of water tanks to Captain E. L. Brady, Mr. Tyler's agent, in command of the Wiggins, and in charge of the excavating operations on the bar under his contract. In the latter part of March following, while at the bar, witnessing the operations of the Wiggins, I described my plan more fully in his hearing. About the middle of last month he showed me in my office drawings of a device which he had conceived, depending upon my plan, as I had described it in his hearing; the application of the plan differing considerably, however, from the one I submit herewith. I have just been informed that he has applied for a patent in the premises. Whether or not his patent, should he obtain it, will cover the *principle* involved, that of using propellers in connection with adjustment of draughts, as stated, for the purpose of excavating under running water, I am unable to decide. It might be worth while to refer to the Commissioner of Patents on the subject. Although I had no intention of patening myself any device involving the principle named, or the principle itself, (were such a thing possible,) I certainly did not authorize Captain Brady to do so.

The surveys of Southwest Pass and Pass à Loutre by the coast survey parties designated for that purpose under my direction have been completed, and full reports, illustrated by charts, submitted to me. From these I have caused deductions to be made, a statement of which is herewith respectfully submitted. These show, as I had anticipated, that Pass à Loutre possesses decided advantages for improvement over the other pass; although owing to the rapidity of the current and the imperfect character of the appliances available for the purpose, the investigation of the character of the sub-strata of the bars was not as thorough as was desired. Moreover, as hitherto remarked, the absence at Pass à Loutre of the throng of vessels at some seasons obstructing Southwest Pass, constitutes a consideration of vast importance in favor of the former.

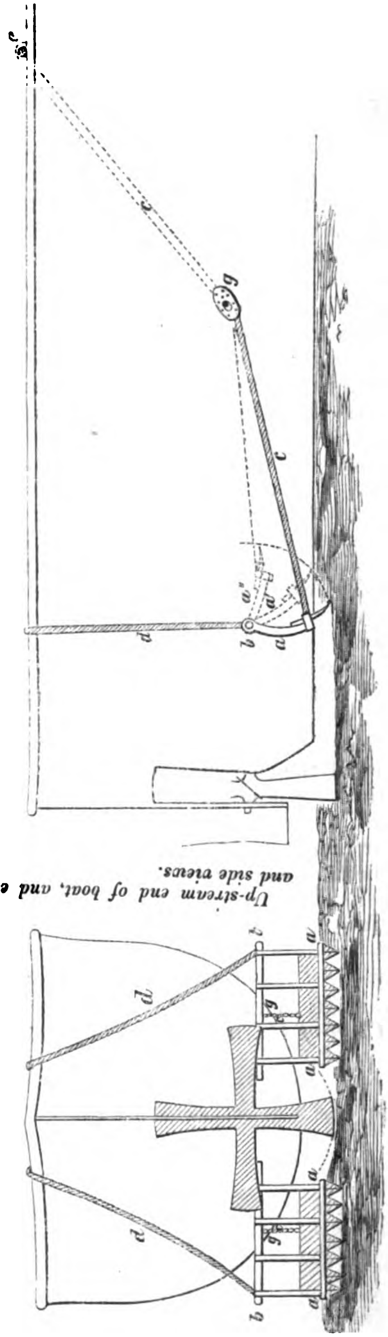
I therefore recommend, unreservedly, that Pass à Loutre be selected for future operations.

Very respectfully, your obedient servant,

M. D. McALESTER,
Brevet Brigadier General, Major of Engineers.

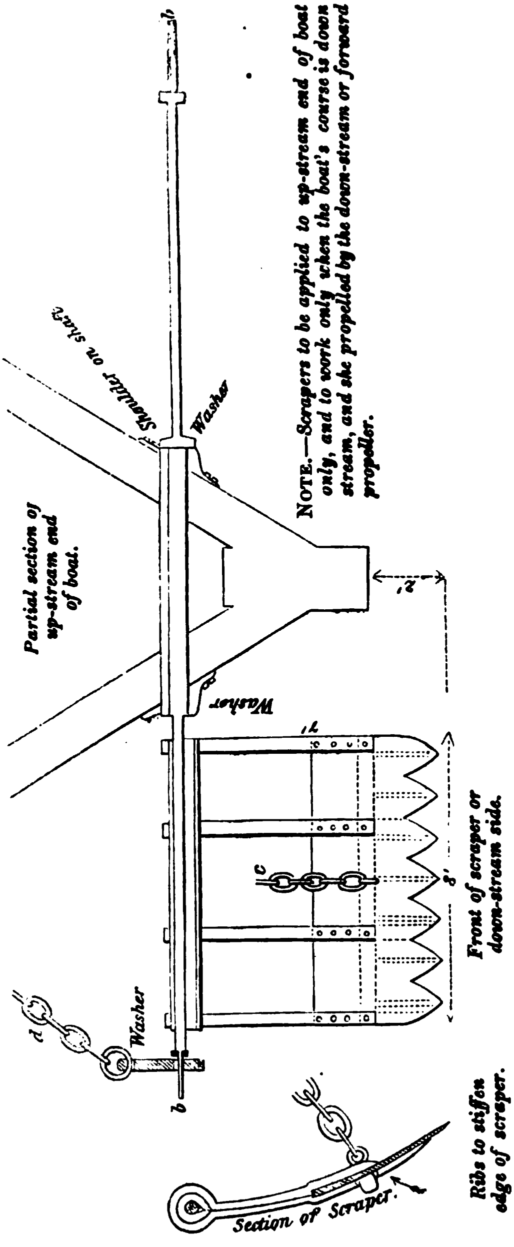
Major General A. A. HUMPHREYS,
Chief of Engineers, Washington, D. C.

Improvement of the mouth of the Mississippi river.—Dredge-boat.—Proposed application of scrapers.



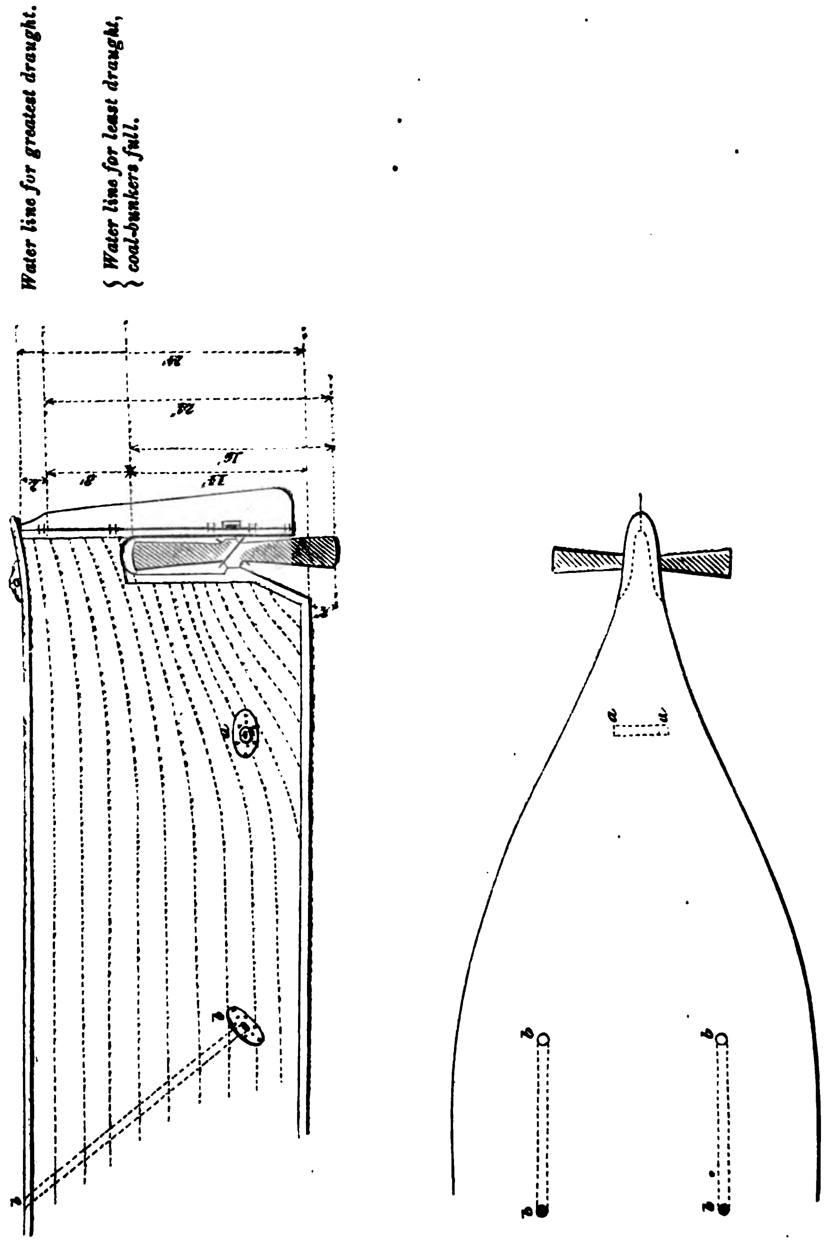
Up-stream end of boat, and end and side views.

a, scrapers in position for deepest cutting; *a'*, position for less depth of cutting; *a''*, position of scrapers raised clear of bottom passing up stream across bar; *b*, cast-iron shaft for scrapers; *c*, chains holding scrapers in position; *d*, chains attached to washers on ends of shaft, holding scrapers and shaft against any tendency to motion in direction of axis of shaft; *e*, windlasses on deck for holding and adjusting scraper-chains; *g*, hawser-holes through which scraper-chains pass.


b
Shoulder on shaft
Washer
Partial section of up-stream end of boat.
2'
Washer
1'
c
8'
Front of scraper or down-stream side.
Washer
d
b
Section of Scraper.
Ribs to stiffen edge of scraper.

NOTE.—*Scrapers to be applied to up-stream end of boat only, and to work only when the boat's course is down stream, and she propelled by the down-stream or forward propeller.*

Improvement of the mouth of the Mississippi river.—Plan of proposed dredge-boat.


Water line for greatest draught.
Water line for least draught, coal-bunkers full.
24'
22'
16'
2'
8'
14'
a
a
a
b
b
b
b
b
b

The dredge-boat to be a "double-ender" of like shape and construction at both ends, provided with two strongly built four-bladed propellers, one at each end, on separate shafts, powerfully driven by separate engines, or sets of engines, and with compartments or tanks, such that when they are empty and the coal-bunkers full the boat will draw fourteen feet, and when full twenty-two feet.

The distance between the spar deck and bottom of the keel to be about 24 feet, so that the former will be about two feet above the water-line at deepest draught.

The extremities of the propeller blades to describe circles of 16 feet diameter; their shaft centres to be six feet above the bottom of the keel, and directly over it, so that the ends of the blades will pass two feet below the bottom of the keel, and at minimum draught (coal-bunkers full) tangent to the water surface.

Length and beam to depend mainly upon the space and flotation required for boilers, engines, pumps, and other machinery, coal storage, quarters for crew, and the consideration of a good model. The beam can probably be safely assumed at 30 feet, and a well-proportioned length would probably be at least 150 feet.

SPECIFICATIONS.

Hull.—Of wood, constructed with as much strength throughout as is possessed by first-class Atlantic steamers, and, moreover, to be re-enforced at both ends in the most practicable manner to the extent of affording complete security against injury from shocks occasioned by the propeller blades striking the tough clay incrustations covering portions of the Mississippi river bars. Dead-wood to be built in at the stems, so as to increase their stability and steadiness against shocks. The model to be so formed as to give the least practicable resistance, consistent with strength and other primary considerations, to progress through the water, and to speed. The bottom to be covered with yellow metal to the water-line at 18 feet draught. Cut-waters to be inclined near the keel, so as to clear well the space about the propellers at that point.

Spar deck.—To be flat as possible consistent with adequate drainage; surrounded with a substantial railing, and as clear as possible of obstructions, especially from the stems to distances of 40 or 45 feet towards midships.

Propellers and shafts.—These to be, say, twenty-five per cent. heavier and stronger than would be necessary for ordinary sea-going steamers. The pitch of the blades to be that which is most approved for speed and efficiency in water. The ends of the blades, and the edges for a distance of two feet from the ends, to be given well-defined edges, the angles of which being, say, 25 degrees. Shafts to be confined by means of bearings of unusually great numbers and strength, (to avoid as much as possible vibrations caused by impact of the propeller blades against hard or tough substances,) and to be provided with shoulders of sufficient number and strength to prevent the possibility of any longitudinal motion by the unusual strain in that direction to which they will be subjected.

Rudders and rudder-posts.—All these to be wrought iron. Posts to extend to within, say, two feet of the bottom of the keel; to be well secured to the ends of the propeller shafts, resting against these and held there firmly by means of bolts or journals in prolongation of the axis of the shafts, the journals passing through the posts and taking keys or heads on the outside. So much of the posts as interfere with unshipping the propellers to be movable. Rudders to admit of being unshipped, of course. Rudders to be so arranged as to be fixed at will in positions parallel to the keel.

Water tanks for regulating draught.—These to be arranged in sets running fore and aft; each set to be equally distributed on both sides of the keel, to have the areas of its cross-sections perpendicular to keel, proportional to the areas of the corresponding cross-sections of the hull from stem to stem, and to be subdivided in such a manner as to confine the contained water and prevent its following any motion of the boat, for the purpose of obviating as far as practicable any tendency to "shift cargo." The tanks or compartments of each set to be connected by apertures; these to be fitted with convenient devices for firmly closing and opening them at will. Each tank to have a manhole, admitting of the removal of sand and mud (precipitated by the contained water) when pumped dry. The tanks to be filled by means of scuttles placed just below water-line for minimum draught when the coal-bunkers are empty, and emptied through scuttles placed just above water-line for maximum draught, by means of pumps driven by donkey engines.

The capacity of these scuttles and pumps to be sufficient to fill all the tanks within, say, thirty minutes, and to empty them in a like space of time.

All scuttles to be fitted with convenient devices for securely closing them, and those *admitting* water to the tanks to be also fitted with substantial strainers.

Propeller engines.—Each propeller to be driven by a power, say, twenty-five per cent. greater than would be required for a like propeller in an ordinary sea-going steamer. This to be accomplished by means of two cylinders placed base to base, with their axes in the same right line perpendicular to the shaft, the common base of the two cylinders being directly over the prolongation of the shaft; each piston-rod being connected with the crank-pin by means of two short connecting rods and a rock-shaft with two arms strongly made and mounted, an arrangement adopted generally on sea-going monitors, giving great simplicity and compactness while obviating all dead points.

Boilers.—The two sets of engines driving the two propellers should be supplied by steam from separate boilers, or sets of boilers, so arranged, however, as to be all connected together, and disconnected at will.

The several donkey engines ought also to have separate boilers.

Furnaces.—These to be adapted for burning soft coal.

Storage for coal.—Sufficient coal storage to be provided to supply the furnaces of *all* the engines on board one hundred consecutive hours of uninterrupted running.

Anchors and cables.—Three anchors, each capable of holding the boat against the Mississippi river current, and five chain cables of weight and strength to correspond to the anchors, of the length usually provided for sea-going ships.

Masts and sails.—One short mast rigged for a fore-and-aft sail, with sail and rigging all complete; and the gaff fitted completely for hoisting coal on board.

Quarters.—To be provided below spar deck for thirty men, and a house, say fifty feet long by eight feet wide, running fore and aft amidships on the spar deck, to be fitted up for an office and quarters for six persons, (one officer, ship's captain, mate, purser, and two steersmen.)

Pilot-house.—One pilot-house amidships on top of officers' quarters.

Pumps.—An ample supply of steam and hand pumps for putting out accidental fires, washing decks and other necessary purposes, with full supply of hose to lead to every part of the boat; steam pumps to be worked by steam from the main boilers.

Arrangement for attaching two scrapers, one each side the keel at either end of the boat, at will.—At a point near each stem, say twelve feet distant from it, and five feet above bottom of keel, a cylindrical tube of boiler iron five inches interior diameter (*a*, see sketch) to be inserted, running from out to out of the hull, athwart ships or at right angles to the keel, and projecting far enough on either side to take a large and strong wrought iron washer which is to be accurately fitted and strongly bolted to the ship's side, and to present a shoulder three inches wide around the aperture of the tube, the plane surface of the shoulder being perpendicular to its axis.

At points at least twenty-four feet from these tubes or apertures (measured parallel to the keel and towards midships,) and eight feet (measured horizontally) from the middle of the keel, hawser-holes to be inserted (four in all) through the boat's sides, connecting with the spar deck by means of strong cast iron tubes extending up obliquely towards midships, large enough to admit short-linked three-fourth inch chains, (*b*, see sketch.)

Should the iron in contact with the yellow metal sheathing give rise to too rapid oxidization, any other equally strong metal can be substituted.

Small boats.—One life-boat, two yawl-boats for ten oars each, and one skiff for four oars; all to be of the best and most durable material, and of the best models for speed and efficiency. Two sets of davits, with complete rigging for lowering and hoisting these boats at convenient points, one on each side of the dredge-boat.

The dredge-boat is to be fitted up with all devices, fixtures, appliances and accessories (except such as may hereafter be specially designated) that are usually provided for first-class ocean steamers; everything pertaining to the boat to be of the very best material and constructed and applied in the most skilful and workmanlike manner.

Respectfully submitted:
M. D. McALESTER,
Brevet Brigadier General, Major of Engineers.

Major General A. A. HUMPHREYS,
Chief of Engineers, Washington.

Deductions from a special survey made by parties of the Coast Survey during April and May, 1867, *under direction of Brevet Brigadier General M. D. McAlester, engineers.*

	Southwest Pass.	Pass à Loutre.
Distance across the bar between 20 feet curve	14,583 feet	8,750 feet.
Width of assumed channel, mid-channel line being the line of deepest soundings	150 feet	150 feet.
Mean depth of water in present channel	17.19 feet	15.38 feet.
Mean depth of excavation for a 20 feet channel	2.81 feet	4.62 feet.
Number cubic yards of excavation for a 20 feet channel	221,661	224,582.
Least depth of water on mid-channel line	11 feet	11 feet.
Average velocity	3'.066, (5' below surface)	3 feet 9 inches.
Consistency of bottom of channel, as ascertained by thrusting down a pole at different points	Station A, water 6 feet deep, soft mud for a depth of 8 feet; no sand. Station B, water 7 feet deep, soft mud for a depth of 8 feet; no sand. Station C, water 15 feet deep, stratum of hard sand and clay 6 inches thick; soft mud and sand below. Station D, water 15 feet deep, clay and sand for a depth of 5 feet; clay very sticky. Station E, water 16 feet deep, soft mud for a depth of 2 feet. Station F, water 18 feet deep, soft mud and sand. Station G, water 19 feet deep, soft mud and sand.	Station A, water 12 feet deep, a stratum of hard sand and clay 2 feet thick; soft mud below. Station B, water 11 feet deep, very hard sand and mud, unable to sink pole to a greater depth than 4 feet. Station C, water 14 feet deep. soft mud; pole thrust down 5 feet. Station D, water 17 feet deep, very soft mud.

REMARKS.

A comparison of these data with the Coast Survey chart shows that the bottom of the channel of the Southwest Pass, between the upper 20-foot curve and the wreck, a distance of about two and one-third miles, is composed of soft mud mixed with a small quantity of sand; between the wreck and the outer 20-foot curve, about one-half of a mile, incrustations of a fine sticky clay with occasionally some sand, varying in thickness from six inches to eight feet, are found.

These incrustations exist in patches throughout the greater portion of the channel between the limits just named; below, and in the intervals between them, the bottom is of soft mud.

At Pass à Loutre, between the upper 20-foot curve and the crest of the bar, a distance of about one and one-fourth mile, the bottom is composed of soft mud with a little sand; from the crest of the bar to the outer 12-foot curve, about eight hundred feet, a hard incrustation of sand and mud, varying in thickness from two to four feet, is found; from the outer 12-foot to the outer 20-foot curve the bottom is of soft mud.

There is a mud lump covered with a hard crust two feet thick in the south side of the channel, about 175 feet from the outer 20-foot curve.

This lump is about 300 feet long and 160 feet wide, and would project about 60 feet into a channel 150 feet wide, passing to the north of it.

Respectfully submitted:

M D. McALESTER,
Brevet Brigadier General.

Major General A. A. HUMPHREYS,
Chief of Engineers, Washington, D. C.

APPENDIX H.

Report of Colonel J. N. Macomb.

OFFICE OF WESTERN RIVER IMPROVEMENTS,
Cincinnati, Ohio, September 20, 1867.

GENERAL: I respectfully submit herewith my annual report upon the duty of improving the western rivers, &c., to which I was assigned by Special Orders No. 418, dated War Department, Adjutant General's Office, August 22, 1866, and your letter to me of September 3, 1866.

By Special Orders No. 447, War Department, Adjutant General's Office, September 7, 1866, Brevet Major C. W. Howell, captain of engineers, was assigned to duty as my assistant, and reported to me on my arrival here.

The appropriation for building snag-boats and for making the requisite examinations and surveys, and for commencing the improvement of these rivers, were made by the act of Congress approved on the 23d of June, 1866.

I have thus far merely caused such examinations of the Arkansas, Missouri, and Mississippi rivers to be made as would suffice to show at what points it would be most important and useful to commence work when all the means and appliances therefor shall be in readiness for use, it seeming on all sides to be conceded that the amount of work required for these improvements is so great as clearly to come under the designation of indefinite, both as to extent and as to the time required for accomplishing it.

My attention was called in the first place to the duty of procuring the proper boats and machinery for this work. On inquiry I found that there was nothing suitable to be had by purchasing, and I recommended that we should build the boats and machinery.

About the end of November I received from the engineer department drawings of one of the old snag-boats used on these waters some twenty years since, and after a careful study of the plan on the part of my assistants and myself, I called to my aid Mr. E. M. Shield, one of the most experienced and judicious mechanical engineers of the west, by whom were prepared the models and specifications for a snag-boat and machinery, which were submitted to the engineer department on the 13th of February, 1867, and approved on the 26th of the same month.

Important changes were made in the plan of the boat and machinery. In the first place the machinery for hauling out snags is quite independent of the propelling wheels of the boat, thus giving a much better command of the whole power, and affording the means of controlling the position of the boat while grappling with a snag or other obstruction to be removed from the river. Auxiliary engines are also introduced for various duties which were done by hand in the old plan; this will probably increase the efficiency of the boat, while the crew may be much smaller than it was found necessary to have in the old boats.

In accordance with instructions, I advertised for proposals for building three boats, with appliances as above, and at the expiration of the time for receiving bids I reported to the department touching the embarrassment which I felt, arising from the fact that while the lowest bidder for hulls of boats worked in one city, the lowest bidders for cabins and other important parts worked in quite different places, and I asked that I might so give out the contracts as to have each boat completed and equipped at some one locality; but this was deemed to be not in accordance with the law, and I was directed to give out the contracts strictly in conformity with the lowest bids for separate parts of the boats, so that one of the boats which we are building at Cincinnati will be towed to Madison to receive its cabin and machinery, and the boat which is building at New Albany will need to be towed up to Louisville to receive its machinery; and there are other anomalies of similar import incidental to the requirement of taking, in all cases, the "lowest responsible bidder."

The plan of receiving bids only from persons manufacturing or dealing in the articles wanted is doubtless the best one both for the government and for the dealers; but there should be a condition introduced to prevent the difficulties and delays experienced in regard to building these boats or any similar work, and that condition should be such as to require that each boat should be completed and equipped where built. This, I suppose, would be accomplished by fixing upon the towns or places where such work could be advantageously done, and then taking bids for the several classes of work to be done at those places. I trust that authority may be given to the departments having such work in charge to conduct the business in that way or in some better one.

Abstracts of bids and contracts thus far given out under the head of snag-boats are herewith submitted, marked A, B, C, D, E, F, and G.

The hulls of the boats are all well advanced, and can be launched as soon as the water shall have sufficiently risen to make it safe to launch them. The machinery is in a good state of forwardness, and will be ready for setting up as soon as the boats can be placed within the reach of the parties contracting for it.

On the 12th of December, 1866, I sent an assistant to proceed from Cairo, Illinois, to Fort Smith, Arkansas, and note the positions of all the principal dangers to navigation on those parts of the Mississippi and Arkansas rivers embraced in that route. The result of that mission was explained to the department in my letter of the 21st of February, 1867.

A list of the more important obstructions to the navigation of the Arkansas is herewith submitted, marked H.

An inspection of this list will show that there is a great amount of work to be done in that river.

On the 28th of February, 1867, I submitted to the department a report from my assistant, Major C. W. Howell, relative to the removal of wrecks in these rivers, and recommended that a steamboat should be purchased and fitted out with submarine armor, diving-bells, and electro-magnetic batteries for exploding torpedoes, and with derricks and all other appliances for blowing up wrecks and hoisting out the detached parts. This recommendation was approved, and I was directed to advertise for proposals for the sale to the government of a suitable steamboat, which was described in the advertisement. Only one bid was received under this head, and a contract was entered into by which the steamer Commodore was purchased for this service. The alterations and fitting up of this boat being of a nature not easily covered by a contract, I was authorized to have them done by days' work, under the supervision of Mr. Pierce, the assistant whom I had placed in charge of the boat.

This boat, on being fitted up for the wrecking business, was called by me the General J. G. Totten, as stated in my letter of 28th May, 1867.

The boat has been employed in blowing up wrecks in the Mississippi river with considerable success, although laboring under the disadvantage of working in a very high stage of water, which will doubtless render it necessary that the wrecks which were first undertaken should be revisited during the low water of this fall.

My first instructions to the assistant in charge were to proceed in the steamer with the wrecking party to commence removing two wrecks near St. Louis, which were considered as prominent dangers. On reaching St. Louis a supply of powder for use in the torpedo cans was procured at the United States arsenal, the ordnance department having authorized its sale to me for this purpose. The first work undertaken was the removal of the White Cloud and Belle Memphis, lying together just off the lower part of the city of St. Louis. The work upon these wrecks was continued until the 25th of June, when, as well as could be judged at the high stage of water then prevailing, it was deemed to have been accomplished, and was left with the intention of returning to make further examination during the low water of the fall. While the boat was at the above work there occurred the lamentable accident of the sinking of the steamer Governor Sharkey in that vicinity, on which occasion our wrecking party was instrumental in saving life, as reported by me in a letter dated July 1, 1867.

On the 27th of June the wrecking steamer reached Memphis with a view to the removal of the wreck of the Jeff. Thompson, which had been the means of causing the disaster to the steamer Platte Valley, with great loss of life. The party continued to work in the vicinity of Memphis during the greater part of July, and worked at the wreck of the old wharf boat, which had encumbered the Memphis landing. This wreck and that of the Jeff. Thompson were worked upon until they seemed to be destroyed, as well as could be judged in the high stage of water then obtaining. I doubt, however, if it is, in all cases, possible to clear away a wreck without the aid of the powerful machinery of the snagboats in addition to the shattering first done by the torpedoes.

While working in the vicinity of Memphis the crew suffered greatly from sickness, incidental to the climate. My assistant gratefully acknowledges, under date of 15th of July, the important and timely aid rendered by Assistant Surgeon Tremaine, of the medical department United States army.

The party continuing to suffer from sickness, the steamer was brought up to the mouth of the Ohio, where I visited it as soon as I could, and on the 5th of August reported to the Chief of Engineers the condition of the party, and requested authority to send the boat up the Mississippi to work at the removal of the wreck of the Northern Light, in Coon Slough, being in the district allotted to General Warren, who, not being yet prepared to undertake that piece of work, had expressed to me a wish that the wrecking boat could be sent thither for that purpose. My request was approved and granted, and the work has been done, as reported by me in a letter of the 20th of September, 1867.

In the course of the month of April, it being evident that a long time must elapse before any of the boats authorized to be built and equipped for this service could be in readiness for use, I was directed to advertise for proposals for boats fully equipped with crews and machinery to commence the work of clearing away the snags and other impediments of that sort in the upper waters of the Arkansas and Missouri rivers. I accordingly published the required notice in the latter part of April, and on the 28th of May, 1867, reported the result of that advertising to the department. The bids were deemed to be excessive, and I was ordered to advertise again. On the 31st of July I reported the result of this second advertising, and on the 7th of August I was authorized to conclude the contracts under these last bids.

These contracts were approved on the 19th of August, and the contractors are now at work upon the Arkansas river with the steamer North West, and upon the Missouri river with the steamer Underwriter, on board of each of which steamers there is a supervisor or inspector, in the employment of the government, whose duty it is to make reports to this office in writing once a week, giving a full account of the work done.

Abstracts of the bids and contracts for this sort of work are herewith submitted, marked No. 1, No. 2, and No. 3.

In order to ascertain where work upon the Missouri river was most needed, I sent Brevet Major C. W. Howell, with instructions dated 24th of June last, to make a careful examination, and report upon that river from Fort Benton to its mouth. In this duty he is assisted by Major F. V. Werner, late of the New York 1st volunteer artillery, who is employed by me for this purpose.

Major Howell has not yet returned, and it will be some time after his return before his report can be prepared. It will, however, be finished before the new boats can be got ready to avail of the information which it will afford.

The improvement of these great western rivers is clearly a work which does not admit of permanent completion, for the channels which are in use during a season or more may be suddenly abandoned by the rivers in the course of the changing stages of the water. The rivers cut out for themselves new channels, which, in their turn, require to be freed from snags to render them safe for navigating; their improvement must, therefore, be carried on with successive annual appropriations for working the snag-boats, and for constructing such additional ones as may be shown to be necessary from the experience to be gained by the use of those now in the course of construction.

From the lists of dangers to the navigation herewith submitted, it is apparent that there is enough to be done to employ snag-boats and their working parties for many years to come. (See lists marked H and K, also L, herewith submitted.)

It was suggested by the convention of steamboat masters and owners held at St Louis, Missouri, on the 14th and 15th of May last, that the establishment of lights by the general government at points where dangerous obstructions exist, or long crossings are required to be made, would contribute greatly to the safety of lives and property. This is doubtless true, and where the obstructions consist of permanent rocky ledges or reefs is well worthy of attention.

The amount of commerce and navigation to be benefited by the carrying on of these improvements is the whole great inland commerce of the west, and the navigation of all the great western rivers, which greatly affects the commerce of the whole United States, the facilitating of which will promote that of the world.

The amount that can be profitably expended upon these improvements in the next fiscal year is shown in the estimates which I have forwarded to the engineer department.

The experience to be gained by the practical working of the means and appliances about to be used in the removal of obstructions can alone determine to what extent it may be advisable to modify these estimates in the future.

All of which is most respectfully submitted by your most obedient servant,

J. N. MACOMB,
Colonel Engineers, Brevet Colonel United States Army.

Brevet Major General A. A. HUMPHREYS,
Brigadier General Commanding Corps of Engineers,
United States Army, Washington, D. C.

A.—*Abstract of proposals for hulls and attachments for three double-hulled steam snag-boats.*

No.	Name of bidder.	Residence.	For one boat.	For two boats.	For three boats.
1	Morton & Startzman	Cincinnati, Ohio	$26,000	$51,000	$75,000
2	Sam. P. Hambleton & Co	do	24,900	49,800	74,700
3	Marine Railway and Dock Co.	do	24,400	48,800	73,200
4	Hill, Hewitt & Co	New Albany, Ind	25,700		
5	M. Howard & Co	Jeffersonville, Ind	28,500		
6	Stewart & Barmore	do	26,300	51,100	73,000
7	Vance & Armstrong	Madison, Ind	28,000		
8	William Jones	New Albany, Ind	24,000		

B.—*Abstract of proposals for boilers, engines, and machinery, for three double-hulled steam snag-boats.*

No.	Name of bidder.	Residence.	For one boat.	For two boats.	For three boats.
1	Niles Works	Cincinnati, Ohio	$32,000	$64,000	$96,000
2	Robert Moore & Sons	do	39,600	78,200	115,800
3	Malley & Stemler	do	48,000		
4	C. T. Dumont	do	28,500	57,000	85,500
5	Miami Machine Works	do	50,000		
6	Ainslee, Cochrane & Co	Louisville, Ky	30,000	57,500	85,500
7	Denis Long	do	26,500		
8	Hill, Hewitt & Co	New Albany, Ind	37,000		
9	Neal Manufacturing Co	Madison, Ind	28,500		

C.—*Abstract of proposals for joiner work and cabins for three double-hulled steam snag-boats.*

No.	Name of bidder.	Residence.	For one boat.	For two boats.	For three boats.
1	Hill, Hewitt & Co	New Albany, Ind	$7,500		
2	Morton & Startzman	Cincinnati, Ohio	7,500	$14,500	$21,000
3	James Howard & Co	Jeffersonville, Ind	8,000		
4	Elias Ehler	Cincinnati, Ohio	9,644		
5	Vance & Armstrong	Madison, Ind	7,000		

D.—*Abstract of proposals for tackle, blocks, and cordage, for three double-hulled steam snag-boats.*

No.	Name of bidder.	Residence.	Blocks, spars, and derricks for one boat.	Hemp rope.	Wire tiller rope.
				Per lb.	*Per lb.*
1	Deacon & Depew	New Albany, Ind.	$1,662 00	$0 25	$0 60
2	J. J. Hair	Louisville, Ky.	1,471 00	23	....
3	J. F. Harcourt	Cincinnati, Ohio.	1,606 50	25	90

E.—*Abstract of proposals for painting and glazing for three double-hulled steam snag-boats.*

No.	Name of bidder.	Residence.	For two boats.		For one boat at New Albany, Ind.	For three boats.
			One at Cincinnati, Ohio.	One at Madison, Ind.		
1	W. O. Williams	Louisville, Ky.	....	....	$2,850	....
2	Hill, Hewitt & Co.	New Albany, Ind.	....	....	2,043	....
3	Riggs & Murray	Cincinnati, Ohio.	$1,500	$2,500	....	....
4	D. J. Williams & Co.	......do	....	....	....	$7,200
5	Vance & Armstrong	Madison, Ind.	....	3,500	....	....
6	D. J. Williams & Co.	Cincinnati, Ohio.	1,800	1,800	....	....

F.—*(Miscellaneous.)—Abstract of proposals for iron for chains, making chains, and salt for salting hulls for three double-hulled steam snag-boats.*

No.	Name of bidder.	Residence.	Iron.	For making chains.		Kanawha salt.
				2-inch.	¾-inch.	
			Per lb.	*Per lb.*	*Per lb.*	*Per bush.*
1	Swift's Iron and Steel Works	Cincinnati, Ohio.	$0 8½	....	....	....
2	J. W. Malinee	Louisville, Ky.	....	$0 05	$0 07	....
3	Henry Werry	Cincinnati, Ohio.	....	05	06	....
4	A. H. Moore	......do	....	05	08	....
5	Hedrick & Laidly	......do	....	....	....	$0 50

G.—*Abstract of contracts made on account of the construction of snag-boats and apparatus for clearing western rivers.*

No.	Name of contractor.	Residence.	Date of contract.	Designation.	Amount.	Remarks.
1	Marine Railway and Dock Co.	Cincinnati, Ohio..	May 20, 1867..	Hulls for two snag-boats................	$48,800 00	
2	William Jones................	New Albany, Ind.	May 20, 1867..	Hull for one snag-boat..................	24,000 00	
3	C. T. Dumont................	Cincinnati, Ohio..	May 20, 1867..	Machinery for one snag-boat............	28,500 00	
4	Neal Manufacturing Co.......	Madison, Ind	May 22, 1867..	Machinery for one snag-boat............	28,500 00	
5	Denis Long.................	Louisville, Ky ...	May 20, 1867..	Machinery for one snag-boat............	26,500 00	
6	Morton & Startzman.........	Cincinnati, Ohio..	May 21, 1867..	Cabin and joiner work for one snag-boat.	7,500 00	
7	Hill, Hewitt & Co...........	New Albany, Ind.	May 21, 1867..	Cabin and joiner work for one snag-boat.	7,500 00	
8	Vance & Armstrong.........	Madison, Ind.....	May 22, 1867..	Cabin and joiner work for one snag-boat.	7,000 00	
9	J. J. Hair...................	Louisville, Ky ...	May 20, 1867..	Blocks, tackle and cordage for three snag-boats.	4,413 00	For second tiller rope and shives, $735; hemp rope, 23 cts. per pound.
10	D. J. Williams & Co.........	Cincinnati, Ohio..	July 31, 1867..	Painting two snag-boats................	3,600 00	
11	Hill, Hewitt & Co...........	New Albany, Ind.	Aug. 12, 1867..	Painting one snag-boat.................	2,043 00	
12	Swift's Iron and Steel Works.	Cincinnati, Ohio..	July 29, 1867..	Iron for chains for three snag-boats......	2,209 74	
13	Henry Wery.................	Cincinnati, Ohio..	July 29, 1867..	Making chains for three snag-boats......	*1,500 00	
14	Hedrick & Laidly...........	Cincinnati, Ohio..	....	300 barrels Kanawha salt for hulls.......	†1,000 00	

(*Approximate,) ¾ inch chain, 6 cents per pound; 2 inch chain, 5 cents per pound.
(†Approximate,) 50 cents per bushel.

H.—*List of some of the obstructions to the navigation of the Arkansas river, from its mouth to Little Rock, including White River cut-off.*

Entering White river about ten (10) miles above Napoleon, on the Mississippi, to go into Arkansas river through the cut-off, a distance of eighteen (18) miles; up White river, for twelve (12) miles before reaching cut-off some few snags and logs; also the wreck of the steamer Lady Jackson; through the cut-off, a distance of six (6) miles, very loggy and full of snags. In low water very difficult to make.

On entering the Arkansas river at Napoleon, there are fifteen (15) bends up to head of cut-off, a distance of thirty (30) miles, a great many snags, and three rack heaps, in the way. There are snags and logs in all the bends, some more difficult than others to navigate, especially after night; also two or three wrecks of steamers. No towns, but a great many landings, in that distance.

From the head of the cut-off to Red Forks, a small place on the left-hand side of the river, a distance of twenty (20) miles, there are ten (10) bends. River crooked and snags all the way, and all the crossings in low water get very shoal. Channel narrow, and at extreme low water only navigable for small steamers. Three (3) wrecks of steamers sunk a long time; names of them I do not know. Breaks can be seen in low water from Red Fork to Arkansas Post. The next important place is ten (10) miles; some few landings between. The river considered very good, although in low water a great many bad breaks to be seen. On up the river for five (5) miles you come to Smith's cut-off, a very bad place for logs and snags. On up the river some few snags in the way.

Up to Floyd Smith's landing, a distance of four (4) miles, going on up, snags all the way for seven (7) miles. There you come to the new cut-off, called "Moore's or Smith's Bend cut-off," very crooked and snaggy. Some five (5) miles above you come to Forroley's bend; all snags; a narrow track for a steamboat. From Forroley's cut-off to Pine Bluff, a distance of eighty-nine (89) miles, there are thirty-six (36) bends; all of the bends have snags in, and in low water the river is shoal, excepting in the bends among the logs, which makes the channel very crooked. In this distance there are a great many high snags, of all shapes and sizes; a great many of them we ran over going down stream after night.

Along this one hundred and seventy (170) miles, from the mouth of the river to Pine Bluff, there are upwards of two hundred (200) landings, including wood-yards; there are thirteen (13) wrecks of steamers and barges sunk, that I know of. Only few of them are in the way; some of them show breaks in low water, and some of them are covered up in the bars.

From Pine Bluff to Little Rock, a distance of one hundred and ten (110) miles, there are thirty-three (33) bends and very crooked low-water channel, narrow, and in the crossings always changing; the same nature as the lower part of the river; snags and logs all the way, and bad bars. There are four (4) bluffs come in on the left-hand side (going up) of the river, called "Dug's Bluff," "Yellow Bluff," "White Bluff," and "Red Bluff."

In this distance of one hundred and ten (110) miles, there are upwards of ninety (90) landings, wood-yards included, and fourteen (14) wrecks of steamers and wrecks that I know of. Several of these are very much in the way, and some are covered up in the sand, and some of the breaks can be seen in low water.

The distance from mouth of river to Little Rock I call two hundred and eighty (280) miles. All pilots have their own distance is why I mention this.

EUGENE G. HANDLAN,
Cincinnati, New Orleans, and Arkansas River Pilot.
[Steamer "Bertha."]

A true copy:
J. M. MACOMB,
Colonel Engineers, Brevet Colonel U. S. A.

No. 1.

Abstract No. 1, on account of "improving Mississippi, Missouri, and Arkansas rivers" Proposals for sale to the United States of one side-wheel steamer for removing wrecks, &c., in the above rivers.

No.	Name of bidder.	Town—	State.	Date of advertisement.	Amount.	Remarks.
1	Thomas Murdock.	Cincinnati.	Ohio.	March 11, 1867	$21,000	Only bid received.

Abstract No. 2, on account of improving Missouri and Arkansas rivers, proposals for furnishing boats and equipment for the removal of snags and other obstructions from the upper channels of said rivers by contract.

No.	Name of bidder.	Under advertisement dated—	Residence.	Missouri river.—Price per day of 1 steamer, crew, and equipment of ten hours.	Arkansas river.—Price per day of 1 steamer, crew, and equipment of ten hours.
		1867.			
1	A. Covey	April 27	Post Perry, Pa	$800 per day.	
2	Thomas Murdock	April 27	Cincinnati, Ohio.	240 per day.	
3	Cincinnati Wrecking Boat Company.	April 27	Cincinnati, Ohio.	300 per day.	
4	A. B. Hopkins	April 27	Cincinnati, Ohio.		$175 per day.
5	Arkansas and White River Wrecking Boat Company.	April 27	Cincinnati, Ohio.		170 per day.
6	Thomas Murdock	April 27	Cincinnati, Ohio		245 per day.
1	Cincinnati Wrecking Boat Company.	June 22	Cincinnati, Ohio.	$275 per day.	
2	Arkansas and White River Wrecking Boat Company.	June 22	Cincinnati, Ohio.		$160 per day.

Abstract No. 3, of contract made on account of improving Mississippi, Missouri and Arkansas rivers.

No.	Name of contractor.	Residence.	Date of contract.	Designation.	Amount.
1	Thomas Murdock...	Cincinnati, Ohio.	March 29, 1867.	One side-wheel steamer for removal of wrecks, &c.	$21,000.
2	Cincinnati Wrecking Boat Company.	Cincinnati, Ohio.	Aug. 14, 1867.	Three months' snagging, &c., in Missouri river.	$275 a day.
3	Arkansas and White River Wrecking Company.	Cincinnati, Ohio.	Aug. 13, 1867.	Four months' snagging, &c., in Arkansas river.	$160 a day.

K.

620 Olive Street, St. Louis, Missouri,
September 12, 1867.

Sir: In accordance with your request, I beg leave to submit the following report of the present condition of the Mississippi river from St. Louis to Cairo. In making up this report, I have only taken notice of snags, breaks, and wrecks that are obstructions and dangers to navigation at the present time. The channel of the river is constantly shifting from place to place, and with every change other snags, &c., not mentioned in this report, will become obstructions.

This river is now ten feet above low-water mark, and falling at the rate of three inches in twenty-four hours. There is seven feet water in the channel hence to Cairo; as the river falls the channel will shift and cut out, and the dangers (snags, breaks, &c.) will become more numerous.

Distance from St. Louis in miles.	Obstructions.	Location.
	White Cloud	Foot of Ann street, St. Louis, one wheel four feet dry, and break to the right of wheel, which I suppose to be the bow of the Belle Memphis.
	4 breaks	Head of Quarantine island.
	1 snag...............	In crossing to Cahokia bend.
7 miles	1 break..............	Opposite La Pere towhead.
20 miles	6 snags..............	Two above and four just below Jim Smith's; caving-in bank, with heavy timber on it.
33 miles	3 snags..............	Cornish island.
40 miles	3 snags..............	Rush tower.
41 miles	4 snags..............	Rush crossing.
	4 breaks	Do.
44 miles	6 snags..............	Rush Island bend, with caving bank and heavy timber.
48 miles	1 wreck..............	Head of Fort Charter's island.
	8 snags..............	Head of Fort Charter's island, caving bank and heavy timber.
60 miles	1 snag...............	Head St. Genevieve towhead.
	3 breaks	Do.
62 miles	4 snags..............	Foot of St. Genevieve bend.
	3 breaks	Foot of St. Genevieve bend, caving bank and heavy timber.
65 miles	6 snags..............	Kaskaskia bend, caving bank and heavy timber.

Obstructions, &c., in Mississippi river—Continued.

Distance from St. Louis in miles.	Obstructions.	Location.
66 miles	2 snags	Kaskaskia island.
	4 breaks	Do.
68 miles	3 snags	Salive island, caving bank.
71 miles	8 snags	Pratt's bend.
	1 wreck	Pratt's bend, caving bank, heavy timber.
82 miles	3 breaks	Mary's river.
84 miles	3 snags	Manscoe's island.
84 miles	2 breaks	Do.
88 miles	3 snags	Head of Liberty island.
88 miles	2 breaks	Head of Liberty island, caving bank.
92 miles	1 snag	Sheep island.
92 miles	3 breaks	Do.
98 miles	3 snags	Below Hening's, caving bank.
104 miles	4 snags	Wilkinson's island, caving bank.
107 miles	3 snags	Kelly's landing, caving bank.
110 miles	1 break	Hat island; (this break cost the steamboat interest over $100,000 last fall.)
120 miles	10 snags	Around Tower island.
	12 breaks	Around Tower island, caving in bank and heavy timber.
130 miles	3 breaks	Neely's.
132 miles	1 wreck	Devil's Tea-table.
	2 breaks	Do.
139 miles	4 wrecks	Bainbridge's.
140 miles	4 snags	Key West Point.
142 miles	3 snags	Kinney Point, caving bank.
143 miles	6 snags	Devil's island, caving bank and heavy timber.
150 miles	4 snags	Cape Giradeau bend.
166 miles	4 snags	Head of Powers's island.
167 miles	3 snags	Foot of Burnam's island.
169 miles	1 snag	Goose Island landing.
180 miles	2 snags	Corner Buffalo island.
	1 break	Do.
185 miles	1 wreck	Head Dog-tooth bend.
186 miles	2 snags	Dog-tooth bend above Thompson's.
	4 breaks	Dog-tooth bend at Thompson's.
	2 snags	Dog-tooth bend below Thompson's; one of the snags and two of the breaks below Thompson's are very difficult (on account of the narrow channel) to pass in safety; snags four feet in diameter.
187 miles	1 snag	Sister island.
190 miles	18 snags	Greenleaf's bend, bank caving in rapidly, very heavy timber.
192 miles	4 snags	Missouri Point below Sister island.
194 miles	2 breaks	Elk island.
194 miles	1 snag	Do.
197 miles	3 breaks	Head Bird's towhead.
198 miles	6 breaks	Fort Bird's towhead.
	4 snags	Do.
200 miles	1 snag	Mouth of the Ohio river.
200 miles	1 rock	Do.
	1 rock	At the foot of the Grand chain, called the Paul Jones Rock. The Totten can take these two rocks and the big snag at the foot of Dog-tooth.

Pilots from below report having sounded and passed over the place where the Jeff. Thompson lay, and find no remains of that vessel. When the Totten was at the wrecks of the White Cloud, Belle of Memphis, and Jeff. Thompson, she worked under many disadvantages—high water, rapid current, &c.

The Jeff. Thompson's casements were over three feet solid oak, locked and interlocked; her head solid and well fastened for ramming. After what she (the Totten) has accomplished under such unfavorable circumstances, what can she not do with a fair chance?

In the above report you will find eight wrecks of steamers, 63 breaks or snags under water, and 137 dry snags that are now obstructions or dangers to navigation between this place and the junction of the Ohio and Mississippi rivers. Truly a formidable array; but when this river has fallen six or seven feet more, the number of snags and breaks will be more than doubled.

Those caving in banks, with heavy timber, is the principal cause of snags; the heavy roots of trees are a sufficient anchor to hold until the tree becomes firmly bedded. But I fear to trespass, and will close. I arrived here at six p. m., and leave at daylight in the morning for Helena, Arkansas, consequently I have had but very little time to write up the above report.

I shall take notes on my trip to Helena and return, and if they would be of any service to you, would be pleased to send them.

Your learning and experience forbid my making suggestions until called for. I have had some experience in snagging, (as we called it on the old boats,) and do not hesitate to offer my services to you in any capacity.

I will be absent some eight or ten days on this trip, and on my return, with your permission, will write again.

I have the honor to be, very respectfully, your obedient servant,

JOHN S. TENNYSON,
St. Louis and New Orleans Pilot.

Colonel JOHN N. MACOMB,
Corps of Engineers U. S. A., Cincinnati, Ohio.

A true copy:

J. N. MACOMB,
Colonel Engineers, Brevet Colonel U. S A.

L.

List of steamers sunk in the Mississippi river between St. Louis, Missouri, and Cairo, Illinois.

*Belle Memphis, by ice, foot of Ann street, St. Louis, Mo.
*White Cloud, struck wreck, foot of Ann street, St. Louis, Mo.
*Governor Sharkey, overloaded, foot of Ann street, St. Louis, Mo.
Shepherdess, struck break, Cahokia bend.
*——— ———, opposite La Pere river.
——— ———, opposite Jefferson Barracks.
Virginia, struck break, head Carroll's Island.
Fisher, struck break, foot Carroll's Island.
*——— ———, opposite Cave hollow.
Elvira, struck break, foot Widow Beard's island.
——— ———, at Foster's.
Tonaleuka, struck break, foot Widow Beard's island.
Missouri, burned, above Merrimac.
——— ———, above Merrimac.
——— ———, at Widow Waters'.
Windsor, struck break, opposite Sulphur springs.
Amazon, struck rocks, opposite Rattlesnake springs.
——— ———, Harlow's.
Robert Fulton, rocks, Platin rocks.
Emma Boyd, break, opposite Tilly's.
*Wm. L. Ewing, break, opposite Tilly's.
*———, break. Wreck of Ewing, opposite Tilly's.
Dunkirk, break, opposite Rush island.

*———, break, opposite Rush island.
West Wind, break, opposite Rush Tow head.
——— ———, head Fort Charter's island.
Cambria, break, head Turkey island.
Corsair, break, foot Turkey island.
Rienzi, wreck of Corsair, foot of Turkey island.
Yucatan, wreck of Rienzi, foot Turkey island.
Atlanta, break, foot Turkey island.
Rubicon, break, foot Turkey island.
Sultan, burned, St. Genevieve.
Omega, break, St. Genevieve.
——— ———, head St. Genevieve island.
Wyacondia, break, St. Genevieve bend.
Leander, break, head Kaskaskia island.
J. M. Convers, ice, Ferry island.
Columbus, old age, Saleve island.
Naugatuck, break at Saline, St. Mary's landing.
*Thos. H. Larkin, burned, Pratt's bend.
——— ———, head Horse island.
Vermillion, rock, above Mary's river.
Anglo-Saxon, rock, below Mary's river.
Little Franklin, break, Manscoe's island.
Defiance, break, at liberty.
——— ———, foot Liberty island.
Tennessee Valley, break, big Eddy.
Glasgow, collision, Devil's Back-bone.
——— ———, rocks, at Wilkinson's.
*Honduras, break, Kelly's landing.
———, break, opposite Kelly's landing.
Duke of Orleans, burnt, foot Lacour's island.
Maid of Orleans, break, head Hat island.
General Jessup, wreck United States, head Hat island.
United States, break, head Hat island.
New York, break, head Hat island.
Hamlet, break, head Hat island.
Manona, break, head Hat island.
New York, break, head Hat island.
Jas. E. Woodruff, break, head Hat island.
——— ———, head Fountain bluff.
——— ———, opposite Kount's landing.
——— ———, head Tower island.
Meridian, break, opposite Upper Mouth Muddy.
——— ———, opposite Upper Mouth Muddy.
Georgetown, break, below Upper Mouth Muddy.
Walk-in-the-Water, old age, Sheffield.
Gondolier, collision, Preston.
Loyune, ———, Crawford.
——— ———, Hanging Dog rock.
*Olive, snag, Devil's Tea-table.
*———, snag, Devil's Tea-table.
Wiota, break, Sablett's.
Missouri Belle, break, Bainbridge.
———, break, Bainbridge.
*Chester, break, Bainbridge.
*General Pike, Wreck Chester, Bainbridge
Key West, break, Key West Point.
*Union, break, opposite Sheppard's.
Swiftsure No. 3, break, opposite Sheppard's.
Kate Kinney, break, Kinney point.
——— ———, above head Devil's island.
Fort Pitt, break, around Devil's island.
Jas. Montgomery, break, Devil's island.
John Swasey, wreck Montgomery, Devil's island.
*Bell Golding, break, Devil's island.
Lasalle, break, foot Devil's island.
Jas. Robb, supposed rocks, foot Devil's island.
——— ———, Old Cape.
India, powder, Cape College.
Talisman, collision, foot Cape Girardeau bend.
——— ———, foot Cape Girardeau bend.

J. M. White, rocks, Grand chain.
Homer, rocks, Grand chain.
Wm. Parish, rocks, Grand chain.
John Hancock, rocks, Grand chain.
*Paul Jones, rocks, Grand chain.
Alhambra, rocks, Beaver dam.
Roanoke, rocks, Beaver dam.
A. M. Phillips, break, Doolan's slough
———, break, Doolan's slough.
New Orleans, break, foot Burnam's island.
Aunt Letty, break, foot Burnam's island.
Paragon, break, Illinois side Goose island.
———, break, Illinois side Goose island.
———, break, Illinois side Goose island.
———, break, Illinois side Goose island.
J. P. Tweed, break, Illinois side Goose island.
Mentor, break, Mentor point.
*Felix Grundy, foot Goose island.
*Rowena, break, Buffalo island.
*———, break, Buffalo island.
———, break, Hucker's bend.
———, break, Hucker's bend.
———, ice, Widow Brooks's.
———, ice, Widow Brooks's.
Saladin, break, head Dog-tooth bend.
*——— ———, head Dog-tooth island.
Orient, break, in Dog-tooth bend.
Narragansett, break, foot Dog-tooth bend.
Manhattan, break, foot Dog-tooth bend.
Swatara, collision, head Missouri Sister.
Sam Lay, break, Illinois Sister.
Boston, ice, foot Able's towhead.
Eliza, snag, Eliza Point.
Mound City, want of caulking, opposite Eliza Point.
Daniel Pollard, ———, Eliza Point.
*——— ———, Bird's tow-head.
Ben. Lewis, explosion, junction Ohio and Mississippi rivers.
Grand Tower, Cement rocks, junction Ohio and Mississippi rivers.
Glendy Burke, Cement rocks, junction Ohio and Mississippi rivers.
Chancellor, Cement rocks, junction Ohio and Mississippi rivers.

The above list is made from memory; the names of some of the boats are unknown or forgotten, left blank. These marked * are obstructions to navigation. Break is a hidden obstruction, stumps, logs, &c., under water.

I have a full list, but it is not with me at present.

Very respectfully, your obedient servant,

JOHN S. TENNYSON,
St. Louis and New Orleans Pilot.

A true copy:

J. N. MACOMB,
Colonel Engineers, Brevet Colonel U. S. A.

APPENDIX H.

OFFICE OF WESTERN RIVER IMPROVEMENTS,
Cincinnati, Ohio, February 28, 1867.

GENERAL: I beg leave to submit herewith the report of my chief assistant, Brevet Major C. W. Howell, in relation to the removal of wrecks in western rivers, which was alluded to in my letter of 21st instant as in the course of preparation.

It will be seen by this report that a suitable boat can probably be purchased for about $20,000, and fitted for the service for about $5,000, in addition to which would be the cost of a diving-bell, or submarine armor. The gunpowder for this service could, doubtless, be furnished from the public supplies now on hand.

Instead of using Beardsley's exploding apparatus, I should prefer to avail myself of the benefit of the recent researches which, I understand, have been made by Brevet Major King, of the corps of engineers.

Believing it to be of the utmost importance that the chief wrecks named in the report should be removed as soon as possible, I would respectfully request to be authorized to apply the requisite funds from the appropriation for the "improvement of the Mississippi, Missouri, Arkansas, and Ohio rivers," for carrying out the project now submitted.

I remain, very respectfully, your most obedient servant,

J. N. MACOMB,
Lieutenant Colonel Engineers, Brevet Colonel U. S. A.

Brevet Major General A. A. HUMPHREYS,
Brigadier General and Chief of Engineers,
Washington, D. C.

OFFICE WESTERN RIVER IMPROVEMENTS,
February 28, 1867.

Report of Brevet Major C. W. Howell, captain engineers, upon the removal of wrecks in the Mississippi river, &c., approved, with the slight modifications named in the accompanying letter of this date, with which this report is now respectfully submitted to the Chief of Engineers.

J. N. MACOMB,
Lieutenant Colonel Engineers, Brevet Colonel U. S. A.

OFFICE WESTERN RIVER IMPROVEMENTS,
Cincinnati, Ohio, February 28, 1867.

COLONEL: In obedience to your orders of the 21st instant, I have the honor to make the following report, viz., first, as to the number and location of wrecks in the Mississippi river; second, the manner in which it is proposed to remove them; third, the boats and tackle necessary; fourth, the comparative cost and advantages of chartering and of buying a steamboat:

First. Accompanying this report I send a list of wrecks, for which I am indebted to Mr. A. G. Hiner, a well-known river pilot. Although the list is incomplete, there is enough shown to make the importance and extent of the work appear.

Second. To remove the wrecks, it is proposed either to charter or buy a steamboat and furnish it with torpedoes and electrical machine for blowing up the obstructions, so that, either by lifting with powerful cranes or by pulling, they may be removed piece by piece.

Third. The torpedoes will be simply tin cans of gunpowder; the exploding apparatus, Beardsley's; the cranes worked by steam; also a double-geared capstan forward and a hand capstan aft; diving-bell and armor. The boat should be of light draught, strongly built, with powerful engines and large wheel. For particulars of machinery I will refer you to the report of Mr. Pierce, submitted herewith.

Fourth. I have been unable to find a boat suitable for this service that can be chartered, and I do not think it would be advisable to make further efforts in that direction, for the following reasons:

1st. The insurance on a boat licensed to carry gunpowder will be very heavy, and, as the owner will insist upon insurance, the expense must be added to the charter.

2d. I know of no boat on the river properly arranged for this service. There must be a clear deck in front of the chimneys, and the hull forward must be strengthened by strong timber bulkheads. The first will necessitate the cutting away the forward cabin of the boats here in use, and the second will fill up the forward hold so as to render it almost useless for freight.

3d. A wrecking boat will be needed for the next five years, and will in that time pay for itself several times over; that is, if we are to judge from the average charters paid here during the war.

Accompanying this report you will find a list of steamboats now offered for sale; also a general description of each boat. I have informed myself as well as possible about each, and would recommend the side-wheel boat Commodore as the one best suited for the service. The report of Mr. Pierce will give you her description in detail.

I have examined the ferry-boats in use here, and find them in very bad condition. They are not calculated to run against a stiff current, and are deficient in power. I would recommend them as worthless for our use.

I have the honor to be, colonel, very respectfully, your obedient servant,

C. W. HOWELL,
Captain Engineers, Brevet Major U. S. A.

Brevet Colonel J. N. Macomb,
Corps of Engineers, Colonel U. S. A.

List of boats offered for sale.

	Price.
Commodore, side-wheel, (see report of C. E. Pierce,) about	$20,000
Bertha, stern-wheel; 3 boilers, 24 feet by 36 inches; 15-inch cylinders, 5-foot stroke; length, 165 feet; beam, 32 feet; about	15,000
Argosy, stern-wheel; 3 boilers; 16-inch cylinders, 5-foot stroke; length, 165 feet	20,000
Nymph, stern-wheel; 10-inch cylinders; length, 149 feet; not serviceable	6,500
Delaware, stern-wheel, at Pittsburgh, (not first class;) dimensions about same as Bertha	10,000
Charleston, stern-wheel, at Memphis, (not first-class;) dimensions about same as Delaware	14,000

List of wrecks between St. Louis and Vicksburg.

Belle Memphis lies between St. Louis and Carondelet.

Hat island, opposite Wittenberg, a number of old wrecks not now in the channel, but may be, on account of channel shifting.

Montgomery lies in the channel near Devil's island; room enough for boats passing.

Paul Jones lies in Grand chain, between Thebes and Commerce, Missouri.

Goose island, one wreck; not now in the channel; was formerly.

B. M. Runyon, James White, and Fred Tron, island No. 10. These wrecks lie between New Madison and Point Pleasant. The Fred Tron and James White are considered dangerous.

Sunnyside lies at island No. 16; not a channel obstruction.

Ben Stickney lies between islands No. 20 and No. 21, near the shore.

H. D. Newcomb, near Hale's point, Tennessee; not an obstruction.

Old wreck at Plum point, in the channel.

Niagara and Empress lie at island No. 34; also one old wreck. These, however, do not now obstruct the channel, but may on account of shifting.

Rebel gunboat Jeff. Thompson lies between Memphis and island No. 46, in the channel.

City of Memphis in the channel near island No. 52.

Di Vernon lies near island No. 69.

Wrecks near Columbia, Arkansas, not now in the way.

Wreck near island No. 103, not dangerous.

OFFICE WESTERN RIVER IMPROVEMENTS,
Cincinnati, Ohio, February 28, 1867.

COLONEL: In accordance with your orders dated February 25, 1867, I have the honor to state that I proceeded to Carrollton, Kentucky, and made a thorough examination of the side-wheel steamer Commodore, the result of which is as follows:

Extreme length on deck, 175 feet; depth of hold, four feet six inches; breadth of beam, twenty-eight feet; one capstan, worked by hand; tonnage, 348 tons; full-length cabin, with twenty-eight state-rooms and office.

Machinery.—Three double-flued boilers, twenty-two feet long, thirty-eight inches in diameter. Cylinders nineteen inches in diameter, stroke six feet. One doctor engine and pumping apparatus complete. Diameter of wheels twenty-seven feet.

Draught of water.—Forward, sixteen inches; midships, twenty-two inches; aft, nineteen inches.

Condition of hull.—The timbers are 3½-inch by 5-inch oak, sound and in good order, the planking is good and well fastened, the deck beams all sound and well put in, deck plank sound and in good condition, the cabin and upper works are all in good order and well painted, steering apparatus in perfect order. She is between two and three years old, and appears to be in perfect running order; machinery in good repair and works well.

In the event of the purchase of the above steamer, I would suggest the following alterations and additions: To get necessary room to work advantageously forward, the boiler and hurricane decks should be cut off forward of the chimneys. Two bulkheads should be added fore and aft, and hull should also be sheathed nearly one-half its length inside, for the purpose of supporting the strain that may occur in the use of cranes. Two cranes and one diving-bell, and all necessary machinery for use of same. One steam capstan should also be added forward, and the hand capstan now on the boat be placed aft.

Five thousand dollars will be the approximate cost of the above repairs and additions.

Respectfully submitted:

CHARLES E. PEIRCE, *Assistant.*

Colonel J. N. MACOMB,
United States Engineers.

Schedule of approximate cost of working a wrecking boat per month.

WAGES.

One pilot	$250
One mate and 2d mate	230
One steam-engineer and 2d engineer	225

One carpenter	$100	
Two diving-bell men	300	
Two firemen	100	
Twelve laborers, $40 each	480	
One cook and assistants	125	
One cabin boy	25	
		$1,835
One blacksmith		100
Total wages		1,935
Fuel		750
Oils, &c.		50
		2,735
Stores		265
Total working expenses		3,000

Respectfully submitted:

CHARLES E. PEIRCE, *Assistant.*

H 2.

ENGINEER DEPARTMENT,
Washington, April 17, 1867.

SIR: I respectfully transmit herewith a copy of a letter from Colonel J. N. Macomb, corps of engineers, with schedules of bids received for building double-hulled snag-boats for the western rivers.

Separate proposals were submitted as follows:

For hulls and attachments.
For joiner work and cabins.
For boilers, engines, and machinery.
For painting and glazing.
For tackle, blocks, and cordage.

The lowest bidders for hulls and attachments are:

William Jones, of New Albany, Indiana, for one hull, &c., at	$24,000 00
Marine Railway and Dock Company of Cincinnati, Ohio, for two hulls, &c., each at	24,400 00

The lowest bidders for joiner work and cabins are:

Vance & Armstrong, Madison, Indiana, for one boat, at	7,500,00
Morton & Stratzman, Cincinnati, Ohio, for one boat, at	7,500 00
Hill, Hewett & Co., of New Albany, Indiana, for one boat, at	7,500 00

The lowest bidders for boilers, engines, and machinery are:

Dennis Long, of Louisville, Kentucky, for one boat, at	26,500 00
C. T. Dumont, of Cincinnati, Ohio, for one boat, at	28,500 00
Neal Manufacturing Company, of Madison, Indiana, for one boat, at	28,500 00

The lowest bidders for tackle-blocks and cordage are:

J. J. Hair, of Louisville, Kentucky, for blocks, spars, &c., each	1,471 00
For hemp rope, &c., per pound	23
Deacon & Depere, of New Albany, Indiana, for tiller rope, per pound	60

I recommend that the contracts be awarded to the above, on the requisite security being furnished.

The lowest bidders for painting and glazing are:

Riggs & Murray, Cincinnati, Ohio, who propose for three boats $4,500 00

I recommend that their bid be accepted, provided they will do the work for one boat at New Albany or Louisville, and furnish the required security, &c.

If they will not do the work at New Albany or Louisville, then the next lowest bidders for one boat are Hill, Hewett & Co., of New Albany, Indiana, who propose at $2,043, to whom the contract may be awarded.

It will be observed that Colonel Macomb, in view of difficulties which he suggests, recommends that all the bids be rejected; but as this, in the opinion of this department, would not be in accordance with the provisions of the law, his recommendations are not concurred in.

Very respectfully, your obedient servant,

A. A. HUMPHREYS,
Brig. Gen. and Chief of Engineers, Maj. Gen. Vols.

Hon. E. M. STANTON,
Secretary of War.

MAY 6, 1867.

Report of Chief of Engineers approved.

E. M. STANTON,
Secretary of War.

OFFICE OF WESTERN RIVER IMPROVEMENTS,
Cincinnati, Ohio, April 6, 1867.

GENERAL: I herewith transmit abstracts of the bids received, under the following heads, for the construction of snag-boats:

Hulls and attachments; joiner work and cabins; boilers, engines, and machinery; painting and glazing; tackle, blocks and cordage.

On examining the bids it will be found that they come from the following named places, viz: Cincinnati, Ohio; Madison, Indiana; Jeffersonville, Indiana; Louisville, Kentucky; and New Albany, Indiana; and that whilst the lowest bid for hulls and attachments is in New Albany, Indiana, the lowest bid for machinery is in Louisville, Kentucky; the lowest bid for cabins and joiner work is in Madison, Indiana; and the lowest bid for painting is in Cincinnati, Ohio. I find, on inquiry of several of the parties making bids, that their expectation is to do the work at their own places of residence or of business, so that if I have the hulls built at New Albany I must bring them up the river to Louisville to be fitted with machinery, and thence up to Madison, Indiana, for cabins, and thence to Cincinnati to be painted. This would certainly lead to great delay and trouble, and to expense which no bidder has included or considered in his bid; and yet the law requires the work to be given to the lowest responsible bidder. Now if "responsibility" means money responsibility, to be determined by the bonds which the bidders offer as security, all would seem to be on a par, for in all cases the bondsmen are vouched for by the proper government officials; but if I understand this business it is not bonds or money responsibility that is wanted in this case so much as good mechanical work, for which the government will pay to the parties doing the work in cash, (reserving the usual percentage,) at reasonably short intervals, upon proper inspections, estimates, and reports, as may be agreed upon when the contracts shall be drawn up.

I observe that the instructions of the department require me to "reserve the right of rejecting any and all bids," and I will therefore recommend that all the bids be rejected, and that we establish by the aid of these bids, and by what we know of the value of the work required to be done, a price for a snag-boat completely finished, as our specifications call for, and then offer the boats to be built and finished at such established price, as follows: One to the mechanics at Louisville, Kentucky, and Jeffersonville, Indiana, and two to those of Cincinnati, Ohio, and that the offers be confined to such bidders as have the reputation of doing the best work in their several branches of business.

I believe that, by this plan, the community will be satisfied, and that the government will get the best result and in the shortest possible time, as the rivalship existing among the several different localities above named will naturally conduce to this favorable result.

I remain, very respectfully, your obedient servant,

J. N. MACOMB,
Lieutenant Colonel Engineers, Bvt. Col. U. S. A.

Brigadier General A. A. HUMPHREYS,
Maj. Gen. Vols., Chief of Engineers, U. S. Army, Washington, D. C.

APPENDIX I.

Annual report of W. Milnor Roberts, superintending engineer Ohio river improvement, made to Major General A. A. Humphreys, Chief of Engineers United States army, for the year ending June 30, 1867.

GENERAL: In obedience to instructions contained in the circular of the engineer department, No. 11, dated January 10, 1867, I respectfully present the following annual report upon the surveys and works under my charge as superintending engineer of the Ohio river improvement.

My appointment to this duty is dated August 3, 1866. After making the necessary preliminary arrangements, in accordance with the written instructions from the department, dated September 5, 1866, I chartered the steamer Greenback, Captain John Rodgers, and taking with me Captain George W. Rowley, consulting pilot, and Thomas P. Roberts, assistant engineer, made a preliminary examination of the entire length of the river, as described in my report dated December 25, 1866.

I also made a preliminary special report dated September 25, 1866, recommending the construction of riprap dams at the following points on the river, upon all of which work had formerly been done under the direction of Captain Sanders, between the years 1837 and 1844. Upon all of these work has been in progress during the present year, and it is expected that they will be completed on or before December 1, 1867.

The distances of these works below Pittsburg and names of places are shown in the annexed table:

WORKS UNDER CONSTRUCTION.

White's ripple, 11 miles below Pittsburg.
Logtown bar, 18 miles below Pittsburg.
Twin island, 85 miles below Pittsburg.
Captina island, 107 miles below Pittsburg.
Fish Creek island, 112 miles below Pittsburg.
Petticoat bar, 146½ miles below Pittsburg.
Muskingum island, 174 miles below Pittsburg.
Blennerhassett's island, 185 miles below Pittsburg.
Buffington island, 214 miles below Pittsburg.

SURVEY OF THE OHIO RIVER.

The fall of 1866 proved to be very unfavorable for surveys on the river, owing to a succession of freshets keeping the river from falling to a low stage. No engineering party was organized that season.

In accordance with instructions of the engineer department, I organized two surveying parties, which were placed on their respective survey boats on the 25th of June last; one party under the direction of Sigismund Low, esq., assistant United States civil engineer, to survey the river from near Gallipolis to Cincinnati, about 200 miles; and the other under Alonzo Livermore, esq., assistant United States civil engineer, to survey between Cincinnati and Louisville, about 145 miles. Upon completing which sections, if the season admits of it, they are to proceed with the surveys between Louisville and Cairo, about 400 miles, or as far down as they can before the severe weather sets in.

Each party consists of one assistant in charge, one transitman, one leveller, two rodmen, two flagmen, two chainmen, two axemen, and two boatmen, with such occasional help as might be found needful; each party having a floating boat to live in.

Mr. Livermore accepted the appointment on this river with the understanding that in case the work of improving the Des Moines rapids of the Mississippi river should be put under contract he would take a position there as a civil engineer on the engineering staff of Major General J. H. Wilson. Accordingly he left the Ohio river survey at the close of July, to go to his present post at Keokuk. The survey of that part of the river has since been under the charge of James E. Day, esq., assistant United States civil engineer, a competent gentleman of much experience, who had formerly been associated with me in engineering for a number of years.

The object of these surveys is to gather the necessary detailed information respecting the pools, ripples, shoals, islands, &c., below the termination of the old surveys made by Captain Sanders and Mr. Fuller, which ended, (so far as our charts show,) in 1844, 271 miles below Pittsburg; and to obtain reliable maps and charts of the same. These will be useful hereafter when examining and discussing the different plans for the improvement of the navigation of the Ohio, and should always be preserved as valuable records of the present aspect of the stream.

On the 12th of September, instant, the survey of Mr. Low's party had advanced 126 miles, leaving about 73 miles only to reach Cincinnati.

At the same date the survey of Mr. Day's party had advanced 120 miles below Cincinnati, leaving only about 20 miles to reach Louisville.

It may be in place to refer here to the fact that the surveys now being made by General Weitzel, at Louisville, &c., with a view to a proposed canal around the falls, will probably render it unnecessary for my parties to spend much time at that particular point this season.

General Weitzel's surveys, added to those formerly made by the government, will be likely to present all the engineering information needful in connection with the falls, with the old canal, with the new one partly built on the Louisville side, and with the projected canal on the Indiana side.

The present surveys along the Ohio river being but partially completed, and still in active progress, the data obtained is, of course, not yet in shape for a complete report, and cannot be until after the close of the season.

At some of the ripples, at the time the surveying parties passed, the water was rather high for careful investigation and soundings for showing the bars, low-water channels, rate of currents, &c. These can be obtained at a more favorable period hereafter, either this fall or next season.

The maps of the river between the end of the old survey, 271 miles below Pittsburg and Louisville, will, however, be ready for the department not long after the respective parties conclude their field duties. They are upon the same scale as those on the upper part of the river, 1,000 feet to an inch.

Until the survey is completed, at least as far as Louisville, showing the upper Ohio, it would be premature and unsatisfactory to enter upon a minute description of part of the details eliminated.

My report of December, 1866, published in the appendix to the report of the Chief of Engineers United States army, contains a general description of the river, with approximate distances, &c. These assumed distances will be, of course, somewhat modified by the surveys, and will be correctly given hereafter from the actual measurements. But the main features of the river will be found as described in that report, to which the department is respectfully referred.

At the end of the fiscal year ending June 30, 1867, the surveying parties had only been organized six days, namely, at the date of June 25, so that the expenditures under the particular head of "surveys" of the river will come in the statement of the fiscal year ending June 30, 1868.

The expenditures for "preliminary examinations and surveys" made during the autumn of 1866, in September and October, and up to the 30th of June, 1867, amounted to $6,677 82.

The total amount expended on preliminary examinations and surveys, up to the 31st of August, 1867, is $11,955 38.

I estimate that the cost of the necessary examinations and surveys of the Ohio river, from the beginning of September, 1866, (upon the plan adopted,) to the end of the fiscal year, ending June 30, 1868, will be $22,000. Of which there were expended, charged to that fund, during the fiscal year ending June 30, 1867, $6,677 82. Leaving to be expended during the fiscal year ending June 30, 1868, $15,322 18.

During the season of 1868, after June 30th, I think it would be advisable to have a small appropriation applicable to this fund, say $10,000.

WORKS ON THE RIVER.

At the time that contracts were made, owing to the stage of the river, the quantities of stone necessary to complete them could not be ascertained with accuracy. Quantities were therefore assumed less than the probable quantities that might be finally required. In the construction of the dams it was afterwards found that the additional quantities needed to perfect them were so considerable that the department directed me to advertise for new proposals for the additional stone, which was accordingly done.

The annexed tabular statement exhibits the distances, names of places, contractors' names, prices, number of cubic yards of stone contracted for, and amount of the original contracts made in 1866:

Quantities, price, &c., at nine riprap dams.

Miles below Pittsburg.	Places.	Contractors.	Price of quarrying and delivering, per cubic yard.	Price of boating and putting into dam, per cubic yard.	Number of cubic yards.	Amount of contract.
11	White's ripple	Swan & Fenlon	$1 75	$1 35	5,000	$15,500
18	Logtown bar	Routh & Lane	1 25	1 00	5,000	11,250
85	Twin island	Manfull & Kerr	1 13	1 47	4,000	10,400
107	Captina island	Routh & Lane	1 25	1 00	3,000	6,750
112	Fish creek	do	1 25	1 00	3,000	6,750
146½	Petticoat bar	King, Reinhart & Co	1 75	85	3,000	7,800
174	Muskingum island	C. M. Cole	1 10	55	4,000	6,600
185	Blennerhassett's island	do	1 10	55	5,000	8,250
214	Buffington island	J. J. Power	1 75	1 20	4,000	11,800
	Total					85,100

It is not probable that a full report upon the surveys can be presented this fall, as it is not expected that they will reach Cairo this season, but a report upon them as far as they shall have advanced at the close of the present surveying season will soon after be in readiness.

The following tabular statement exhibits the distances, names of places, contractors' names, prices, number of cubic yards, and amount of contracts for additional stone at eight riprap dams.

The quantity contracted for originally at Fish Creek island being sufficient, no additional stone has been let:

Additional quantities, price, &c., at eight riprap dams.

Miles below Pittsburg.	Places.	Contractors.	Price of quarrying and delivering, per cubic yard.	Price of boating and putting into dam, per cubic yard.	Number of cubic yards.	Amount of contract.
11	White's ripple	Swan & Fenlon	$1 50	$1 00	3,500	$8,750 00
			....	50	1,800	900 00
18	Logtown bar	Routh & Lane	1 25	1 00	1,275	2,868 75
			....	2 25	1,000	2,250 00
85	Twin island	James Kerr	1 13	1 37	1,200	3,000 00
107	Captina island	Routh & Lane	1 25	1 00	1,000	2,250 00
146½	Petticoat bar	King, Reinhart & Tripp	1 75	85	500	1,300 00
174	Muskingum island	C. M. Cole	1 10	65	4,875	8,531 25
185	Blennerhassett's island	....do	1 10	75	4,500	8,325 00
214	Buffington island	Charles Cable	1 25	75	5,200	10,400 00
	Total					48,575 00

Statement showing the estimated amount of work done on the dams up to the end of July, 1867.

Miles below Pittsburg.	Places.	Contractors.	Price of quarrying and delivering, per cubic yard.	Price of boating and putting into dam, per cubic yard.	Number of cubic yards contracted for.	Amount of contract.
11	White's ripple	Swan & Fenlon	$1 75	$1 35	5,000	$15,500
18	Logtown bar	Routh & Lane	1 25	1 00	5,000	11,250
84	Twin island	Manfull & Kerr	1 13	1 47	4,000	10,400
107	Fish creek	Routh & Lane	1 25	1 00	3,000	6,750
112	Captina island	.....do	1 25	1 00	3,000	6,750
146½	Petticoat bar	King, Reinhart & Co	1 75	85	3,000	7,800
174	Muskingumis land	C. M. Cole	1 10	55	4,000	6,600
185	Blennerhassett's island	.....do	1 10	55	5,000	8,250
214	Buffington island	J. J. Power	1 75	1 20	4,000	11,800
	Total					85,100

Statement showing the estimated amount of work done on the dams up to the end of July, 1867—Continued.

Miles below Pittsburg.	Places.	Contractors.	Amount paid to August 15.	Yet to be paid.	Ten per centum reserved.
11	White's ripple	Swan & Fenlon	$13,707 00	$1,793 00	$1,370 70
18	Logtown bar	Routh & Lane	6,108 75	5,141 25	610 87
85	Twin island	Manfull & Kerr	8,900 10	1,499 90	890 00
107	Fish creek	Routh & Lane	2,790 00	3,960 00	279 00
112	Captina island	do	2,250 00	4,500 00	225 00
146½	Petticoat bar	King, Reinhart & Co.	6,867 00	933 00	686 70
174	Muskingum island	C. M. Cole	4,063 95	2,536 05	406 39
185	Blennerhassett's island	do	6,831 00	1,419 00	683 10
214	Buffington island	J. J. Power	10,080 00	1,720 00	1,008 00
	Total		61,597 80	23,502 20	6,159 76

The contracts for the additional stone are only now being signed, but the parties, as it happens, are either the original contractors or others who operate in harmony with them, so that no material delay has taken place in the management of the work, and I think that all of them will be completed by the contract period, (the 1st of December, 1867,) unless there should be a season of much high water this fall to interfere, which, however, is not anticipated.

The system of laying out and superintending the works with a small engineering party, having the use of a light-draught government steamer, is believed to be more advantageous and more economical than the old plan of having persons stationed at each point. The greater the number of dams that may be going on simultaneously, the better and more economically this system will work.

The plan of measuring the stone by the cubic yard, instead of by the ton, is also believed to be an improvement upon the old mode of measuring by the ton or the draught of the stone boats.

Some of the dams are advanced far enough to show a marked improvement on the depth of water in the channels, and I have no doubt that at each of the works under contract the navigation will be materially benefited by their completion. We may not at the first effort secure exactly the best results; some modifications may become necessary which only experience can regulate.

WHITE'S RIPPLE, (11 miles below Pittsburg.)

It is expected that the work at this dam will be finished about the latter part of October, 1867. Meanwhile the construction of the main longitudinal dam has added about one foot to the low-water depth in the channel and increased its velocity also. The precise effect altogether upon the navigation in this vicinity cannot be accurately determined until after we have had opportunities of examining it in different stages of the water. We have to guard against having too strong a current running obliquely to the left across the longitudinal dam in a coal-boat stage. Possibly it may hereafter become necessary to raise the old cross-dam between the channel and the left shore to equalize the flow, but it is not proposed to do anything of the kind at present, as I hope that a sufficient flow for that purpose may be allowed to pass down to the left of the towhead along the longitudinal dam.

LOGTOWN BAR, (18 miles below Pittsburg.)

The dam at this place, running from the left shore to the bar and ending obliquely against the old partly built dam, is about finished.

That part of the old dam extending from the bar some distance obliquely up stream, pointing towards the right shore, has been removed and put into the new dam. This arrangement leaves a clear, straight, and wide channel near the middle of the river, which, it is believed, will be a permanent improvement of the navigation in low water and in coal-boat stages.

It can be determined hereafter whether any additional work may be necessary to render this part of the navigation complete.

TWIN ISLAND, (85 miles below Pittsburg.)

Nearly all the stone required for the dam at this place has been put in; the main dam is good and will fulfil its purpose.

At the foot of the island there has been a good deal of washing away, leaving much water to escape to the left of the centre bar.

There ought to be a dam put in here, which would take about one thousand cubic yards, and would improve the low-water depth materially. The necessity for this has only recently become apparent.

With this arrangement the navigation at this place will be very much improved. This is one of the instances where everything that might be needed did not appear in the beginning.

CAPTINA ISLAND, (107 miles below Pittsburg.)

The contractors expect to complete this dam about the last of October. The same contractors have the dam at Fish creek and at Logtown bar, and their work is carried on from the same quarry, with their own steamer. There is not yet sufficient stone in this dam to enable me to refer to the practical effect of this improvement, but no doubt is entertained respecting its success.

FISH CREEK ISLAND, (112 miles below Pittsburg.)

At the beginning of this month (September) there remained only about eight hundred and fifty cubic yards of stone to be put in to complete the dam at this place. It will be finished this fall in good season. This is a small dam, of about three thousand cubic yards in all.

Thus far it has been well built, and it will, when finished, improve the navigation at this point materially.

PETTICOAT BAR, (146½ miles below Pittsburg.)

The dam at this place is finished. It presents a fine appearance, and is in all respects complete. Its effect is good, and the low-water navigation is somewhat better than it was.

It only remains to see how this dam, as well as the other dams in process of construction, will stand the ice freshets. The precise action of ice freshets cannot be determined in advance, although no serious injury from that cause is anticipated at this place.

Less work was required here than at most other points, and the advantage to navigation is much less striking than in some of the other cases. It has made a safer navigation at a tow-boat stage.

MUSKINGUM ISLAND, (174 miles below Pittsburg.)

The dam at this place is well advanced and progressing satisfactorily. It will be finished by the first of December.

It is probable that all that is desired at this point can be obtained with fewer cubic yards of stone than were estimated (in all) as necessary, and as a rather larger quantity is needed than was estimated to be necessary at Blennerhassett's Island dam, it is proposed to decrease the quantity to be put in at Muskingum and increase the quantity at Blennerhassett's.

The same contractor has both jobs at the same price per cubic yard, and he is willing to transfer the stone as proposed, so that it will be the same to the government.

BLENNERHASSETT'S ISLAND, (185 miles below Pittsburg.)

There are two dams at this place—one at the head of the island and one at the foot, known as the head dam.

There has been some trouble at the upper or main dam by the sudden breaking away of sixty feet of the bar at the head of the island. This gap was promptly closed by Mr. Cole, the energetic contractor in charge.

A six feet freshet in August washed out considerably more of this sand and gravel bar. It will continue to need attention and some additional stone through another season.

The construction of the Blennerhassett dam has had the effect of raising the water at the dam more than three feet above its former low water height, and the pressure of water is therefore considerable.

When the dams at the head and foot of the island shall have been completed and in use for a time, a better judgment can of course be formed as to their full effect. I have no doubt that they will greatly improve the navigation along that part of the river. It will probably require somewhat more stone (in all) than was estimated to be necessary, partly in consequence of the washing out of the bar, the proper remedy for which is to fill the space thus washed out with stone.

The work will, it is expected, be finished this season before December.

BUFFINGTON ISLAND, (214 miles below Pittsburg.)

The works at this place are in a forward state, and will be completed before December next.

At least half of the flow in low water passes down the narrow chute on the Ohio side of the island, and navigation here becomes difficult and uncertain, and finally ceases sooner than at any place lower down the river. After closing this Ohio chute, it is necessary to build up the long wing dam on the Virginia chute, (shown on the chart,) to prevent the spread of the water out of the channel.

The Ohio chute dam, which is well advanced, is now turning a large volume of water, but a considerable washing out of light sand and gravel in the gap, 175 feet long, is taking place, rendering an additional quantity of stone necessary. Although these works will be completed before December, another freshet season must pass before we can determine finally whether any other work may be necessary at this important point.

It is believed that the completion of the present plans will make a very material improvement of the navigation.

While the low water navigation will be improved at each of these places, the channels generally will also be rendered better than they were for the coal boating, which, as explained in former reports, has of late years become a most important interest on the river, and should always be kept prominently in view, in considering any proposed plans for the improvement of the Ohio river.

The barge system is on the increase and gradually gaining favor, and it is highly probable that for freighting coal, iron, and heavy mineral and agricultural products, it will come into more general use, not only on the Ohio, but on the Mississippi.

This is a very important fact in the business of the Ohio river—the general substitution of fleets of barges for the former single steamers, or the plan of floating boxes. It is reasonable to believe that after a while a large proportion of the steamers engaged in freighting will be tow-boats, running in connection with barges. Some single steamers will of course still be useful in carrying on the local passenger and freight business between the numerous commercial points along the river, and there will always be steamers engaged during good boating stages in the long voyages from the waters of the Ohio to the upper Mississippi and Missouri, and also to the lower Mississippi; but the bulk of the freighting will probably be ultimately carried on by means of barges towed by steamers.

Although this branch of the subject belongs appropriately to another report upon which I am now engaged, describing the several plans which have been proposed for the radical permanent improvement of the navigation of the Ohio, it is also deemed proper in this place thus briefly to advert to it.

One object is to show clearly that there is nothing now in progress of construction on the river calculated to interfere injuriously with the barge system of boating, and wherever the navigation is good for fleets of barges, it is good for single steamers.

REMOVING OBSTRUCTIONS FROM THE RIVER.

In accordance with the instructions of the engineer department, I advertised for proposals for furnishing a light-draught steamer, with crane boat, flats, and all necessary tools and fixtures, to be employed by the day, in removing obstructions from the river. Captain John Rodgers, of the steamer Greenback, was awarded the contract, at the rate of eighty-eight and a half dollars ($88 50) per day's work.

Captain John Shouse, of Steubenville, an experienced, intelligent and reliable Ohio river pilot, was appointed inspector for this special service, and entered upon the duty June 11, 1867.

This plan for removing river obstructions, by contract, at a fixed price per day, the contractor furnishing vessels, tools, men, &c., at his own cost and risk, was to some extent experimental. I had formed the opinion that such work could probably be done under this arrangement more economically and satisfactorily than by purchasing vessels, &c., and employing the men by the day or month.

A regular steam snag-boat, it is known, is very costly to construct and manage, and it was believed that a light-draught steamer, with a strong crane boat and a couple of decked flats, would accomplish all or nearly all the work that could be done by the more expensive snag-boat.

Under this contract plan, as under any other plan of government operations on such work, much depends on the experience, ability, and faithfulness of the persons employed. In this respect we have, I think, been fortunate in securing the services of an able, energetic, and honest man for contractor, (Captain John Rodgers,) who is well qualified for this particular duty, and in the appointment of a government inspector, (Captain John Shouse,) in charge of the operations, who is the right man in the right place.

The experiment of removing obstructions on this plan has therefore been conducted under very favorable auspices, and I regard it as a success.

The contract price, as already stated, is eighty-eight and a half dollars ($88 50) per day, and, including the pay of the inspector, the whole cost is ninety-three and a half dollars ($93 50) per day, or, for a full month of 26 working days. twenty-four hundred and thirty-one dollars, ($2,431.)

Allowing that in a favorable season this sort of work might be advantageously carried on between April and November, or during seven months of actual work, it would make the cost for the season seventeen thousand and seventeen dollars ($17,017) for a full season for one boat.

So far as we can now tell, judging from what has been accomplished during about three months in the removal of obstructions, it might require say two more steamers another favorable season to clear the entire river between Pittsburg and Cairo.

At the end of the operations there would be no steamers, boats, &c., on hand to be disposed of.

If two more such steamers were employed this year, and three should be employed next year, the estimated total cost, assuming the same rate per steamer as the present contract price, would be nearly as follows:

Estimated expense of one boat, &c., during the season of 1867..	$14,000 00
Estimated expense of two others, two months, say............	9,724 00
Estimated expense of three boats during the season of 1868, at $17,017 each..	51,051 00
Total from the beginning in 1866.......................	74,775 00

This is believed to be a liberal estimate. The probability is that it may cost something less. It is possible that competent parties might undertake the operations during the ensuing year, at a somewhat lower rate, as there seems to be a downward tendency in prices.

When it is recollected that these obstructions are numerous, many of them sunken barges and wrecks, exceedingly difficult of removal, the total estimated cost appears small when put in comparison with the great benefit their removal is conferring upon the river commerce.

According to my report, dated October 31, 1866, we had noted the following obstructions in the Ohio river:

List of known obstructions, October 31, 1866.

Kind of obstructions.	Upper Ohio, Pittsburg to Louisville, 615 miles.	Lower Ohio, Louisville to Cairo, 400 miles.	Total, 1,015 miles.
Snags, (places)................................	75	15	90
Logs and loggy places..........................	49	17	66
Wrecks...	28	18	46
Sunken boats, barges, &c.......................	72	11	83

It was remarked in connection with this list, that in some places several snags or trees might be found where only a single snag is mentioned; and at points marked "loggy places" there may be a number of logs to be taken out; and that there are also more single wrecks and sunken boats than the table shows; and after that report was written some additional obstructions became known to me.

Having become satisfied that there is not probably any more economical method of removing these obstructions from the river, I had the honor to make a communication to the department, dated September 2, recommending that proposals be received for furnishing two additional steamers, crane-boats, &c., for employment this fall. The department, at the date of September 4, 1867, instructed me to advertise for proposals accordingly, which has been done. The proposals are to be received until noon of the 21st instant, at the office in Pittsburg, Pennsylvania. From the nature of the case, perfectly accurate estimates of the total cost of removing all the obstructions cannot be arrived at in advance; but I think the data now in our possession are sufficient to warrant the assumption that the entire cost will not be likely to exceed the above sum of $74,775. From this should be deducted the sum of $6,140 75 already paid up to the end of August, leaving to be expended, according to the foregoing estimate for work to be done after August 31, 1867, the sum of $68,634 25. Possibly a considerable saving may be effected by modifying the system somewhat, so as to work two sets of crane-boats, flats, &c., under the management of one steamer passing from one set to the other, keeping the two sets of crane-boats always within a few miles of each other.

Under instructions from the department dated December 28, 1866, I have a special report in preparation and nearly finished upon all the different plans which have been proposed for the permanent improvement of the Ohio river. It embraces the reservoir plan, the plan of dams, mounds, and wide, river canal; the plan of locks, dams, and the plan of dams with patent chutes without locks. Either of these plans will necessarily involve the expenditure of a large sum of money, as the report will show.

This special report might have been finished some time ago, but for other imperative calls upon my time and attention, which could not be deferred without injury to the public service. I refer to it here partly for the purpose of mentioning that no works will at this time be recommended to be put under contract which would interfere with either of the more costly plans referred to above. I may add that the longer I study the characteristics of the Ohio river, its peculiar regimen, and its commerce, in connection with the topographical and hydrographical features of the country through which it flows, and of the region of its head streams on the Monongahela and Alleghany rivers, the more complicated and difficult the problem of its radical improvement becomes. But I will not in this place enter upon the discussion which belongs to the other report, and which would be merely repetition.

The riprap dams now in progress, and the others which are recommended, the excavation of parts of bars, the taking away of some rocks, and the complete removal of the numerous other river obstructions, are works deemed to be immediately and urgently needed; and yet the whole of this character of improvements on the entire river will not require a very large sum of money. The direct advantage of navigation to be gained will be far more than commensurate with the outlay; and this expenditure ought not to be delayed on account of other and grander projected or proposed improvements which may follow.

REFERRING TO PROPOSED WORKS ON THE RIVER NOT YET UNDER CONTRACT.

It has been already mentioned that there are a number of places on the river upon which it is proposed to offer special reports, the data for which could not be prepared in detail in time for this annual report. At the same time I consider it important for the interest of western river commerce that provision should be made by reasonable but adequate appropriations for the continuation of the present general system, which is, in brief, a concentration of the water into single channels, by means of proper wing dams; the excavation of portions of certain bars, the removal of some rocks, and the removal of numerous obstructions, consisting of snags, roots, logs, old wrecks, and sunken barges, coal boats, steamers, &c.

An estimate of the probable cost of removing the obstructions, and which can be effected during the season of 1868, has been given in this report. Also, an estimate of the amount required to complete the river contracts now in progress between Pittsburg and Buffington. There were apportioned to the Ohio river the following sums:

By the act passed in 1866, to be applied to improvements, &c......	$100,000
By an act dated March 2, 1867, to be applied to improvements, &c.	100,000
By an act dated June 23, 1866, to be applied to removal of obstructions.	50,000
By an act dated June 23, 1866, to be applied to examinations and surveys	22,000
	272,000

If no more contracts were to be made, these apportionments of the appropriations would not be exceeded; but it is presumed that the government, having resumed the care of the Ohio river and other western rivers, intends to go on with such proper works as will eventually improve their navigation, and that further appropriations will be made for the improvement of the Ohio river.

Without enumerating at this time every point on the river where work may, perhaps, be advantageously put under contract at an early period, I will refer, in a succinct manner, to the general features of the more prominent cases, from a consideration of which the department can form a judgment as to the propriety of the appropriations asked for the Ohio river.

Description of places where work is required on the Ohio river between Pittsburg and Cairo.

GLASS HOUSE RIPPLE, (2 miles below Pittsburg.)

This is one of the worst places on the river in low water, and urgently needs improvement, by a dam of some kind. Within a few days my special report upon this place will be forwarded to the department.

MERRIMAN'S RIPPLE, (10½ miles below Pittsburg.)

Dredging is advisable for the purpose of straightening the channel and improving the approach to White's ripple. Perhaps half an acre in area.

DEADMAN'S RIPPLE, (14 miles below Pittsburg.)

An area of about 250 by 60 feet, about one-third of an acre, which has washed in, should be dredged away. Also, the head of the channel may be greatly improved by a considerable amount of dredging.

BEAVER SHOALS, (27 miles below Pittsburg.)

Five or six hundred feet of old boulder dam, about ten feet wide, two feet deep, should be taken away at upper end and put across from left shore to head of dam, and the left chute should be closed. There should be some dredging of heavy gravel and boulders at the foot to straighten the channel. Some rock excavation will probably be necessary.

RACCOON SHOALS, (29 miles below Pittsburg.)

A moderate amount of dredging here will straighten and improve the channel, to be done simultaneously with the improvement of Beaver shoals.

MONTGOMERY ISLAND, (32 miles below Pittsburg.)

Several rocks here should be taken out.

PHILLIS'S ISLAND, (35 miles below Pittsburg.)

Several rocks here should be taken out.

GEORGETOWN ISLAND, (38 miles below Pittsburg.)

Rocks here are dangerous at a low stage of water, ten or twelve in number, each requiring one or two blasts.

LINE ISLAND, (41½ miles below Pittsburg.)

About one hundred by seventy feet, about one-sixth of an acre, ought to be dredged two feet deep.

BAKER'S ISLAND, (49½ miles below Pittsburg.)

The dam here leaks badly; about twenty-five hundred cubic yards of stone will perfect this work.

CLUSTER'S ISLAND, (52 miles below Pittsburg.)

A dam was planned here by Captain Sanders in 1844. To build it properly will require five or six thousand cubic yards of stone. There is no doubt that the concentration of the water by a dam would be beneficial; but I am not yet prepared to recommend a definite plan.

BLACK'S ISLAND, (54 miles below Pittsburg.)

There is an old unfinished dam here. Fifteen hundred cubic yards of stone will probably complete it. A few rocks should be removed.

BROWN'S ISLAND, (61¾ miles below Pittsburg.)

Gaps in the old curved dam waste considerable water; also some stone needed on the Ohio side. About eight hundred cubic yards in all will probably suffice.

FERRY BAR, (66 miles below Pittsburg.)

A number of considerable rocks should be removed, as the channel is narrow. Many have been taken away through private enterprise.

MINGO ISLAND, (70 miles below Pittsburg.)

There is an old unfinished dam here, which should be finished to improve the low-water navigation. Not heavy work.

WELLS'S BAR, (— miles below Pittsburg.)

Our Captain Rogers removed a large rock from here. The place is nearly as shoal as the Sisters. All the water runs in the channel, and as the bottom is hard gravel, it is probable that dredging will improve it. A boat lately grounded here, after passing the Sisters or Twin islands.

COX'S BAR, (72 miles below Pittsburg.)

This place can be improved by levelling off lumps in the channel. It is only troublesome in extremely low water.

BEACH BOTTOM BAR, (77½ miles below Pittsburg.)

The old unfinished dam at this place should be completed. It will require about 2,500 cubic yards of stone.

BURLINGTON BAR, (86¼ miles below Pittsburg.)

It may be found advisable to build the dam planned here by Captain Sanders for the improvement of the low-water navigation. The water is not deep. It will require about 6,000 cubic yards of stone.

WHEELING ISLAND, (90 miles below Pittsburg.)

A low-water dam at the head is needed to close the Ohio chute, say 1,500 feet long; about 3,500 cubic yards of stone.

BOGG'S ISLAND, (92½ miles below Pittsburg.)

Some clearing away of boulders necessary.

MCMAHEN'S CREEK BAR, (94 miles below Pittsburg.)

There are two channels here. It is likely that the channel could be improved by dredging. If dredging is done along the river it might be tried here. Ultimately one of the channels may be shut if deemed advisable.

FISHING CREEK, (127½ miles below Pittsburg.)

The old unfinished dam at this place should be completed. It will require about 3,000 cubic yards of stone.

WILLIAMSON'S ISLAND, (133 miles below Pittsburg.)

The old unfinished dam at this place should be completed. It will require about 2,500 cubic yards of stone.

WHITTEN'S TOWHEAD, (134½ miles below Pittsburg.)

The old dam at this place is about 800 feet longer than necessary. During the last winter (1866–'67) the ice carried away the lower portion, and pilots now complain that it gives trouble. It certainly ought to be repaired. About 3,500 cubic yards of new stone, in addition to what could be obtained from the upper end of the old dam, will probably suffice.

WELLS'S ISLAND, (138¼ miles below Pittsburg.)

The old unfinished dam at this place should be completed, requiring about 3,500 cubic yards of stone. It will improve the low-water navigation.

MILL CREEK ISLAND, (140½ miles below Pittsburg.)

At the old dam, at the island end, the water is cutting some. This should be stopped and the dam completed. It will need about 1,200 cubic yards of stone.

GRAND VIEW ISLAND, (141½ miles below Pittsburg.)

About one thousand cubic yards of stone can be advantageously applied here in closing gap and strengthening the old dam.

THREE BROTHERS, (158¼ miles below Pittsburg.)

This place can be improved at a moderate expense by dredging Rowland's Race, so as to straighten the channel.

CARPENTER'S BAR, (166 miles below Pittsburg.)

A dam at the head of either side of Marietta island, one and three-fourths miles below, will doubtless benefit this bad place, but it is not certain that it would wholly remedy it. If a dam is built at Carpenter's bar, it will require about 10,000 cubic yards of stone. It is one of the worst places. Sand settles here in some years. In 1859 it was worse than any place between Wheeling and Cincinnati.

MARIETTA ISLAND, (167¾ miles below Pittsburg.)

A special report is to be made. See remarks in my report of December last. It is difficult to decide respecting the mode of removing the trouble at this island in consequence of the peculiar location of the city of Marietta.

COLE'S ISLAND.

The foundation of the old dam here is very good. If raised to a four-feet stage it will benefit medium navigation, which is important at this place. It will require about 3,000 cubic yards of stone.

NEWBURG BAR, (193 miles below Pittsburg.)

There is some cutting by the water at the island end of the old dam at this place. To fill the gap and raise and finish the whole dam will take about 3,000 cubic yards of stone.

BELLVILLE ISLAND, (202 miles below Pittsburg.)

This is a long series of bars and dams, extending for a mile and a half. It may take about 4,000 cubic yards of stone in all to improve this place properly.

SAND CREEK BAR, (219 miles below Pittsburg.)

This point should be improved. A dam seven or eight hundred feet long, of a curved shape, through shoal water, should be built so as to close the left chute. About 900 cubic yards of stone is required.

GOOSE ISLAND, (227 miles below Pittsburg.)

This place can be improved by shutting one channel. If either is closed it must be the right side, as the left is the regular tow-boat channel. About 3,800 cubic yards of stone will answer for this purpose.

LETART'S ISLAND, (232 miles below Pittsburg.)

A valuable low-water improvement will be to finish the dam, to close up the Virginia chute, requiring about 3,000 cubic yards of stone.

EIGHT MILE ISLAND, (255 miles below Pittsburg.)

Requires only a low-water improvement—a dam to contract the spreading water, 600 feet long over shoal water; about 1,200 cubic yards of stone.

RACCOON ISLAND, (273 miles below Pittsburg.)

The channel is very crooked and needs a landmark, say two posts twenty-five feet high, with white boards, for the present, until some trees grow up. Perhaps a little work in channel.

GREEN BOTTOM RIPPLE, (289½ miles below Pittsburg.)

The channel here is crooked, with a hard bottom. Dredging, if practicable, may benefit this place. The channel would be materially improved if straightened.

GUYANDOTTE BAR, (302½ miles below Pittsburg.)

The river is very wide here, and shoal all over. One or two long, low wing dams will materially improve this place, say about 1,200 cubic yards of stone.

BURLINGTON OR TWELVE POLE BAR, (312 miles below Pittsburg.)

There are two chutes here at low water. The left chute should be closed with a curved dam built low and flat. About 4,000 cubic yards of stone.

POAG'S SHALLOWS, (322½ miles below Pittsburg.)

From a point 21 miles above Poag's Shallows to Burk's Point 25 miles below, making forty-six miles distance, a general clearing out of loose rock is urgently needed. Some of the rocks contain ten cubic yards each, in five feet water, requiring blasting. A floating crane boat and flats may be used here to advantage. Some of this sort of work was done in 1844 by Captain Burch, at this place and Doyhan's bar, Guyandotte and Sandy Shallows.

BRUSH CREEK ISLAND, (381 miles below Pittsburg.)

There are three channels here at low water, consequently the water spreads. There is an old partly built wing dam, thrown out from the Virginia side some distance above, which has nearly disappeared in the lapse of time. It has been proposed to make this up and then to throw in another wing dam to the head of the island, or else to extend a wing dam down from the old one. It may take about 5,500 cubic yards of stone to make it complete.

MANCHESTER ISLAND, (391 miles below Pittsburg.)

It is probable that a number of sunken boats at this place hold the sand and obstruct the navigation. Their removal will materially improve it. Until they are removed and the effect observed, I would not recommend the commencement of any dam here. Before these boats were sunk the Manchester channel was much better than it is now.

CHARLESTON BAR.

There is shoal water at the foot, close to Kentucky side, which is the channel only in extreme low water. Half the water wastes here in ordinary low stages. It can be closed by a dam with about 4,500 cubic yards of stone.

FOOT OF AUGUSTA BAR, (426 miles below Pittsburg.)

There is a low, changeable, gravel shoal here. The navigation is bad for about ten miles below. It is probable that if the river is thoroughly cleared of rubbish, a better channel might maintain itself without aid from dams. Only future experience can determine this finally. These remarks apply as far down as Big Snag bar, which is about ten miles below Augusta bar.

FOUR MILE CREEK BAR, (459½ miles below Pittsburg.)

The navigation has been injured here by the accumulation of wrecks. There are two channels. One of them might be closed, making an improvement similar to that at Petticoat bar. It would take about 4,000 cubic yards of stone.

BOSLEY'S OR MEDOC'S BAR, (488½ miles below Pittsburg.)

There are two channels at this point, which are alternatively preferred. A dam may yet be deemed advisable; but a thorough clearing out of the wrecks and rubbish should first be attempted, and the effect noted.

RISING SUN BAR, (508 miles below Pittsburg.)

This is a difficult place. It is reported this year (1867) as the shoalest spot between Cincinnati and Louisville, and I also found this by sounding. There is a sort of backbone across the channel at the head. Experienced captains and pilots, who have been many years in the Cincinnati and Louisville trade, complained to me that this place has been greatly injured by extensive ploughing on the large flat bar for the purpose of obtaining paving stones for Cincinnati and other cities. Persons take off the large stones, and the next succeeding flood sweeps off a portion of the loosened bar. (Further reference will hereafter be made to this evil, which is not confined to this one place.) It occurred to me when viewing this place that a spur dam from the Indiana shore, and a long, oblique wing dam from the Kentucky shore on the bar, by concentrating the water, would materially aid navigation, say at a five feet stage. Dredging also, I think, can be advantageously done at this place. It might require 10,000 cubic yards of stone, in all, for this place.

GUNPOWDER CREEK BAR, (516 miles below Pittsburg.)

This is likewise a bad place in extreme low water. There are two channels here. The Kentucky channel should be closed, (if Rising Sun bar be improved, as it should be.) A long, low dam, requiring about 8,500 cubic yards of stone, would probably make this good.

WARSAW BAR, (534 miles below Pittsburg.)

A broad shoal. The water could be concentrated here by means of two wing dams, requiring about 6,000 cubic yards.

GRASSY FLAT BAR, (595½ miles below Pittsburg.)

Many years ago Captain Shreve built a pile dam here from the Kentucky shore. A new dam from the Indiana shore would leave the middle channel open, and effect an improvement of the navigation. The water is shoal, but the dam would be long, requiring about 6,500 cubic yards of stone.

This brings us to Louisville, at the falls of the Ohio.

End of Upper Ohio.—Beginning of Lower Ohio.—Falls at Louisville.

FALLS OF THE OHIO, LOUISVILLE, (615 miles below Pittsburg.)

The total fall here, at extreme low water, is twenty-six feet in three miles. No work has been done in the river at this point by the government for many years. The old canal and locks, and the new partly constructed canal and locks, remain about as described in my report of December, 1866. But Congress at its second session last spring ordered a special survey of the falls, with a view to a canal improvement on the Indiana side, and the department assigned the duty of making the necessary surveys and report to Brevet Major General G. Weitzel, United States army, who, as I have learned from himself, has been for some time engaged in that duty. One of my engineering parties, which commenced at Cincinnati, has about reached Louisville with our survey of that part of the Ohio river; but assuming that General Weitzel's surveys, added to those previously made by the government, will furnish all needed information at that important point, I have instructed Mr. Day, the assistant in charge, to proceed without unnecessary delay with the survey of the river below Louisville.

PORTLAND BAR, (620 miles below Louisville.)

The channel is changeable here. It crosses from Portland, on the Kentucky side, to New Albany, on the Indiana side. At this crossing there are two channels, which are never both good at the same time. It is a difficult shoal place. On account of the shifting sand it is doubtful whether ordinary riprap wing dams would avail to keep a regular channel. (I am not yet prepared to suggest any precise plan, or to make a definitive recommendation respecting work at this point, or at any place between Louisville and Cairo.)

FLINT ISLAND, (707 miles below Pittsburg.)

The main channel is generally down the Kentucky shore. If dams should be put in, they would be quite long. Nothing determined.

OIL CREEK BAR, (711 miles below Pittsburg.)

There is a shifting sand channel, which often gets very shoal.

HOLT'S BAR, (721 miles below Pittsburg.)

At the head it becomes quite shoal, in extreme low water. Owing to the shifting sands it is difficult to decide upon the plan of improvement.

PUPPY CREEK, (776 miles below Pittsburg.)

Troubled with shoals in low water; there is a hard bottom at this place. Possibly riprap dams may be available here.

YELLOW BANK ISLAND, (779¼ miles below Pittsburg.)

A shoal, crooked place at low water. Dredging here would temporarily straighten the channel.

FRENCH ISLAND, (792½ miles below Pittsburg.)

This is a very bad place. It ought to be helped, if it is possible at any reasonable cost. It should be improved permanently. A large amount has been expended in dams in years past, but they get covered or swamped in the river sands, the channel sometimes making directly over them. No definitive plan yet prepared.

SCUFFLETOWN BAR, (801 miles below Pittsburg.)

A bad place. It is likely that if the old dam were raised, so as to turn more of the water, it would make an improvement of the navigation. As it is a long dam, it would require about 5,000 cubic yards for the purpose.

THREE-MILE ISLAND, (804 miles below Pittsburg.)

This place in late years has not been as bad as formerly. The shoal usually exists a mile below the dam that was put in many years ago. No definite plan has yet been arranged here.

HENDERSON ISLAND, (830 miles below Pittsburg.)

This is a difficult shoal place. Doubtless the cause of some of these sand shoals is the sunken logs which catch and hold the sand. Our consulting pilot, Captain Rowley, is of opinion that elsewhere in the lower Ohio, as well as here, these sunken logs have greatly tended to render such places troublesome to navigation. Their removal will probably materially benefit navigation.

FOOT OF SLIM ISLAND, (853 miles below Pittsburg.)

In my report of last December it was remarked that this place is shoal, difficult at times, and might be improved.

SHAWNEETOWN BAR, (879 miles below Pittsburg.)

This is an especially bad place, partly owing to the great width of the river in this vicinity. A concentration of the water would certainly give a greater depth for navigation, but it will require a considerable quantity of stone, or extensive dams of some kind, to be effectual. Limestone rock exists in the neighborhood. It has not yet been sufficiently examined to decide the particular plan, but it might be assumed, approximately, that 20,000 cubic yards of stone, or an equivalent cost, would make a much better navigation at this point.

CINCINNATI BAR, (890 miles below Pittsburg.)

A changeable place. Latterly it seems to have been rather better than it was some years ago. No plan for its improvement has yet been fixed upon.

BATTERY ROCK, (897 miles below Pittsburg.)

This place frequently becomes troublesome in low water. It has not been reported bad during the present season, up to this time, (September 13.)

TREADWATER BAR, (900 miles below Pittsburg.)

It becomes very shoal at low water, but this part of the river has not been at a very low stage this season.

WALKER'S BAR, (910 miles below Pittsburg.)

This bar sometimes gets very shoal, and it has been reported difficult this year, although the river has not been at its lowest stage at this point.

BIG HURRICANE ISLAND, (913 miles below Pittsburg.)

This is a shoal, crooked, and difficult place. It could be improved by closing the right side with a dam. It should only be improved in connection with an improvement of Walker's bar, by a series of dams across sluices, &c., for three and a half miles. The extent of this work, even should it be deemed advisable, I am not yet prepared to state. There are several wrecks at the head of Big Hurricane island, which must be taken out. Their removal will improve the navigation.

TRYER, OR UPPER SISTER ISLAND, (938 miles below Pittsburg.)

A few loose rocks at this place should be taken out. A steamer was wrecked here during the war. Pilots, in trying to avoid these rocks, sometimes run aground.

SECOND SISTER ISLAND, (938½ miles below Pittsburg.)

It is often very shoal, and may be improved. No plan yet devised.

CUMBERLAND ISLAND, (951 miles below Pittsburg.)

This is a difficult place. The dam, to be effectual here, should be built from the head of Dog island to the head of Cumberland island. It would be nearly a mile longer, but would have generally a harder bottom, and would hold better than the old dam, constructed many years ago. At the foot of the island, dams like the dams at Petticoat bar might be required, though longer. But as there is less current in this place, and nearly all other places below Louisville, than there is on the Upper Ohio, lighter dams will answer.

COTTONWOOD BAR, (956 miles below Pittsburg.)

This is sometimes a difficult place. When the other shoals of the Lower Ohio are improved, an improvement at this place may be devised.

TOWHEAD, FOOT OF TENNESSEE ISLAND, (965½ miles below Pittsburg.)

The same remarks as above apply here.

GRAND CHAIN, (990 miles below Pittsburg.)

This well-known and sometimes very troublesome place extends for about eight miles. The difficulties here are created by a complication of causes, consisting of crooked channels, rocks, sunken logs, wrecks, and the absence of proper land-marks and lights. I have, however, deferred my special report upon this important locality until after an opportunity for a critical examination in a low stage of water.

CACHE ISLAND, (1,007 miles below Pittsburg.)

Navigation at this point only becomes troublesome when the Mississippi, at Cairo, is very low.

This completes the enumeration of all the most prominent points on the Ohio requiring the immediate attention of the government. There are a number of intermediate minor matters, which come under notice as we progress in our operations, which cannot yet be satisfactorily introduced into an annual report.

From the foregoing description of the difficulties in the way of a perfect navigation of this important national highway, it will be seen that, while accuracy as to the probable actual necessary expenditure at particular points is yet unattainable, a very fair general approximate estimate may be made of the probable cost of perfecting such works as are likely to be found necessary and reasonably practicable, and which can be effected at moderate cost, considering the great advantages to be secured to commerce. Without, therefore, having adequate data at a number of places needing improvement, I feel warranted in offering at this time an approximate estimate of the probable cost of completing the necessary improvements of the navigation upon the general system adopted. Above

Louisville, and especially above Cincinnati, a nearer approach to the probable requirements can be made than at points below, owing to the difference in the natural regimen of the river. Below Louisville, on the Lower Ohio, the question is complicated by the river being so much wider, the fall and current so much less, and by the formation of extensive moving sand shoals, the perfect management and control of which has not yet been attained.

RIPRAP DAMS, AND OTHER WORK.

Although I must await the result of the surveys now in progress before reporting all the details of the various points that seem to require special work for the improvement of the low-water navigation, yet an approximate estimate may be made nearly enough to enable the department to decide upon the amount proper to be appropriated for the coming year in this connection. I am now able to make a closer approximate estimate than could be made in September of last year upon the works then recommended to be put under contract, at which time I was also unaware of the rigid character of the act of Congress respecting appropriations in connection with limitations of contracts. I was chiefly desirous at that time that the government should not advertise for more stone than might be ultimately found necessary at those points which were afterwards put under contract between Pittsburg and Buffington island.

Approximate estimate of the cost of completing the system of improvements on the Ohio river, on the general plan of wing dams, with occasional dredging.

1.—BETWEEN PITTSBURG AND LOUISVILLE, 615 MILES.

From Pittsburg to—

[*]Glass House ripple, two miles	$30,000
Horse-tail ripple, five and a half miles	500
Head of Davis island, five and a half miles	3,000
Duff's ripple, eight and a half miles	2,000
Merriman's ripple, ten miles	1,500
Deadman's ripple, fourteen miles	1,500
Beaver shoals, twenty-seven miles	20,000
Raccoon shoals, twenty-nine miles	1,000
Montgomery island, thirty-two miles	200
Phillis island, thirty-five miles	200
Georgetown island, thirty-eight miles	300
Line island, forty-one and a half miles	800
Baker's island, forty-nine and a half miles	6,000
Chester's island, fifty-two miles	15,000
Black's island, fifty-four miles	4,000
Brown's island, sixty-one and three-fourths miles	2,400
Ferry bar, sixty-six miles	500
Well's bar, sixty-eight miles	1,000
Mingo island, seventy miles	6,000
Cox bar, seventy-two miles	500
Beach Bottom bar, seventy-seven and a half miles	7,000
Burlington bar, eighty-six and a fourth miles	15,000
Wheeling island, ninety miles	10,000
Bogg's island, ninety-two and a half miles	400
McMahan creek bar, ninety-four miles	9,000
Fishing creek bar, one hundred and twenty-seven and half miles	8,500

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[*] In case of the adoption of another plan, involving a dam below Burnott's island, the cost would be $240,000.

From Pittsburg to—

Williamson island, one hundred and thirty-three miles	$7,000
Whitton's towheads, one hundred and thirty-four and half miles	10,000
Wells's island, one hundred and thirty-eight and a half miles,	10,000
Will Creek island, one hundred and forty and a half miles	3,500
Grand View island, one hundred and forty-one and a half miles,	3,000
Three Brothers, one hundred and fifty-eight and three-fourth miles	1,500
[*]Carpenter's bar, one hundred and sixty-six miles	25,000
[†]Marietta island, one hundred and sixty-seven and three-fourth miles	20,000
Cole's island, one hundred and eighty miles	7,000
Newburg bar, one hundred and ninety-three miles	7,000
Bellville island, two hundred and two miles	10,000
Grand Creek bar, two hundred and nineteen miles	2,500
Goose island, two hundred and twenty-seven miles	9,500
Letart's island, two hundred and thirty-two miles	7,500
Eight Mile island, two hundred and fifty-five miles	3,000
Raccoon island, two hundred and seventy-three miles	700
Green Bottom ripple, two hundred and eighty-nine and a half miles	1,000
Guyandotte bar, three hundred and two and a half miles	3,500
Burlington, or Twelve-pole creek, three hundred and twelve miles	10,000
[‡]Poag's shallows, three hundred and twenty-two and a half miles,	17,000
Brush Creek island, three hundred and eighty-one miles	14,000
Manchester island, three hundred and ninety-one miles	2,000
Charleston bar, four hundred and eleven miles	11,000
Foot of Augusta bar, four hundred and twenty-six miles	3,000
Four Mile creek, four hundred and fifty-nine and a half miles,	10,000
Bosley's, or Medoc's bar, four hundred and eighty-eight miles,	8,000
Rising Sun bar, five hundred and eight miles	25,000
Gunpowder Creek bar, five hundred and sixteen miles	21,000
Warsaw bar, five hundred and thirty-four miles	15,000
Grassy Flat bar, five hundred and ninety-five and a half-miles,	16,000
Louisville, six hundred and fifteen miles.	
	430,000
Add ten per cent. for superintendence and contingencies	43,000
Total	473,000

2.—BETWEEN LOUISVILLE AND CAIRO, 400 MILES.

From Pittsburg to—

[§]Portland bar, six hundred and twenty miles	$10,000
Flint island, seven hundred and seven miles	15,000
[‖]Oil creek, seven hundred and eleven miles	12,000
Holt's bar, seven hundred and twenty-one miles	14,000
Puppy creek, seven hundred and seventy-eight miles	15,000

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[*] It is not certain that it will be necessary to build this dam. It will depend upon what may be done at Marietta island.

[†] It is believed that any less expenditure at this point would be ineffectual, on any plan that would be deemed proper.

[‡] This applies to a distance of forty-six miles along the river.

[§] For work between the falls and New Albany.

[‖] Probably the construction of a dam here might reduce the work at Flint island.

From Pittsburg to—

Yellow Bank island, seven hundred and seventy-nine and a fourth miles	$12,000
French island, seven hundred and ninety-two and a half miles,	20,000
Scuffleton bar, eight hundred and one miles	15,000
*Three Mile island, eight hundred and four miles	12,000
†Henderson island and head below, eight hundred and thirty miles	10,000
Foot of Slim island, eight hundred and fifty-three miles	5,000
Shawneetown bar, eight hundred and seventy-nine miles	50,000
Cincinnati bar, eight hundred and ninety miles	10,000
Battery Rock, eight hundred and ninety-seven miles	10,000
Treadwater bar, nine hundred miles	6,000
Walker's bar, nine hundred and ten miles	8,000
‡Big Hurricane island, nine hundred and thirteen miles	15,000
Tryer's island, nine hundred and thirty-eight miles	2,000
Second Sister island, nine hundred and thirty-eight and a half miles	10,000
Cumberland island, nine hundred and fifty-one miles	20,000
Cottonwood bar, nine hundred and fifty-six miles	9,000
Towhead, foot of Tennessee, nine hundred and sixty-five and a half miles	20,000
Grand Chain, nine hundred and ninety miles	30,000
	330,000
Add ten per cent. for superintendence and contingencies	33,000
Total	363,000

RECAPITULATION.

Estimated amount that may be required between Pittsburg and Louisville, six hundred and fifteen miles	$473,000
Between Louisville and Cairo, four hundred miles	363,000
	836,000

The sum of eight hundred and thirty-six thousand dollars, in addition to the former appropriations applicable to the improvement of the Ohio river, which former appropriation may be considered as about absorbed by present contracts and necessary general expenses, will, it is presumed, complete the work on the Ohio river, between Pittsburg and Cairo, a distance assumed to be 1,015 miles. All of the work can probably be done during the residue of the fiscal year 1867, and the season of 1868. Contracts cannot be made, as I understand, in advance of appropriations; I would therefore respectfully recommend that the above sum be appropriated in such a manner that the department may be able to make contracts without being compelled to lose any of the favorable parts of the season. If the contracts could be made not later than April, 1868, and a favorable season should follow, the whole series of works might be entirely completed before the setting in of winter the same year, and in many of them time for the fall navigation.

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*This would apply to work that may have to be done near the island, and for a mile or more below.

†In addition to removing numerous sunken logs, &c., it is possible that a dam may be made available.

‡This is intended to apply to dams that will probably be found necessary between Walker's bar and foot of Big Hurricane island.

A special report, to be shortly presented to the department, relating to several different plans for the improvement of Glass House Ripple, two miles below Pittsburg, will show upon one of the plans proposed a considerably larger estimated cost on the alternative plan than is included in the foregoing. It is referred to in a note in the tabular statement of estimated amount required.

The department will understand that I do not profess to have yet arrived at a perfect knowledge of the Ohio river, or all its requirements, in connection even with the present system of improvement; nevertheless, I feel confident that the benefits to be immediately secured to the navigation and commercial interests connected with the river, by the completion of the proposed works will be very great, considering the comparatively small sum necessary for this purpose. It may well be asked, what is a million of dollars compared with the advantages of a much safer river, one thousand miles in length, improved so far as to have always a better low-water navigation, lasting through a longer season each year, and at the same time a superior navigation to the old river in medium and coal-boat stages.

Before concluding, it may not be improper for me to refer to a matter which may be worthy of consideration. Practical difficulties, as the department is aware, sometimes arise in awarding and making contracts for the government, owing to the peculiar wording of the acts of Congress regulating letting of public work. The intention obviously was to establish guards against favoritism in awarding contracts, and so secure as far as possible experts for doing the different branches of work. I think, however, that the public interests could be subserved and proper security still retained by some modification of the present laws, whereby the highest officer of a department should be clothed with some discretionary authority sufficient to present an unnecessary division into separate contracts of parts of a work which ought properly to be in one contract. There has been comparatively little trouble from this source, as yet, on this improvement, owing to the simple character of the operations hitherto commenced. But in case extensive and various kinds of public improvements by the government should continue, it may be important to adopt the best and most effective mode of letting and awarding contracts, as a matter of real economy in the end, and also as a means of securing the best class of contractors. Probably the present laws were arranged more with reference to army contracts than to works of internal improvement.

I would respectfully state that all the (civil) officers engaged in making the river surveys, and in superintending the operations on the improvement under my charge, have conducted themselves in the most satisfactory manner. It is due also to the contractors engaged in constructing the riprap dams, that I should bear testimony to their uniform and most faithful management of the works undertaken by them.

I would take occasion to mention that in my report of December 20, 1866, printed in the "Appendix to report of Chief of Engineers, respecting certain public works," Ex. Doc. 56, part 2, 39th Congress, 2d session, at pages 321 and 322, there is an error in the heading of a table of the stages of water, by the transposing of "Cincinnati" and "Louisville," at the top of the table.

Respectfully submitted:

W. MILNOR ROBERTS,
Superintending Engineer Ohio River Improvement.

PITTSBURG, PA., *September* 14, 1867.

APPENDIX K.

ENGINEER OFFICE, HARBOR DEFENCES,
Baltimore, Md., July 1, 1867.

GENERAL: In obedience to circular from engineer department, dated June 10, 1867, calling for information on certain points connected with the work for "river and harbor improvements" under my charge, viz., the improvement of the Patapsco below Fort McHenry, and of the Susquehanna below Havre de Grace, I respectfully report as follows:

IMPROVEMENT OF PATAPSCO.

Paragraph 1.—Thorough and elaborate surveys have been completed of all the space below Fort Carroll covered by this improvement, and the result has shown conclusively the advisability of a change in the line of the channel from that of the lower part of the old dredged route, or "Brewerton channel." The plan adopted is to dredge a channel 200 feet wide and twenty-two feet deep at mean low water, following the line of the Brewerton channel to a point just below Seven-foot Knoll light-house, where it leaves the old route and takes a nearly due south direction, striking the deep water of the bay near foot of Gibson's island. The expenditures under this plan have been confined to repairs of dredges, scows, and tug.

Paragraph 2.—The estimated amount required to complete this improvement is $250,000.

Paragraph 3.—The amount to be profitably expended during next ensuing fiscal year is $125,000.

Paragraph 4.—The work is located in the collection district of Baltimore.

Paragraph 5.—Near port of Baltimore, extends from Lazaretto light, past Fort Carroll and Seven-foot Knoll light, and below Bodkin Point light.

Paragraph 6.—The amount of revenue collected during last fiscal year was $5,613,983.

Paragraph 7. The whole foreign and coastwise trade of Baltimore, including regular lines of packets to Liverpool, Bremen, Hamburg, the West India islands, and ports on the coast north and south.

Paragraph 8.—*Abstract of proposals for repairs of hulls and wood-work of United States steam dredges, tug, and scows.*

Bids received.	Cooper & Slicer.	Hooper & Co.	Jones & Ashcroft.	J. T. Tardy & Bro.	J. H. Smith & Co.
MATERIALS.	*No.* 1.	*No.* 2.	*No.* 3.	*No.* 4.	*No.* 5.
Select white oak plank, per foot, board measure	$0 07	$0 06	$0 06	$0 07	$0 06
Select white oak timber, per cubic foot.	pads 72 dippers 60	48	54	60	48
Select North Carolina timber, per cubic foot.	pads 54 dippers 42	48	54	60	54
Select North Carolina plank, per foot, board measure	05	06	06	07	06
Hand-made wrought iron spikes	13	12	11	15	10
Machine-made wr't iron spikes	12	10	11	15	09¼
Bolt iron, per pound	07	08	07	10	07
Navy oakum, per pound	13	12	12	16	12
North Carolina pitch, per gallon	35	40	30	50	28
Gas tar, per gallon	20	25	20	25	25

Paragraph 8.—*Abstract of proposals for repairs, &c.*—Continued.

Bids received.	Cooper & Slicer.	Hooper & Co.	Jones & Ashcroft.	J. T. Tardy & Bro.	J. H. Smith & Co.
LABOR.	*No.* 1.	*No.* 2.	*No.* 3.	*No.* 4.	*No.* 5.
Sawing, per running foot	$0 04	....	....	....	....
Use of shears, per day	....	....	....	....	$5 00
Hauling upon railway, per job, dredges	25 00	$25 00	$30 00	$15 00	35 00
Hauling upon railway, per job, scows	10 00	15 00	10 00	....	10 00
Hauling upon railway, per job, tug	....	....	20 00	....	12 00
Use of ways, per day, dredges	12 00	½ price.	15 00	5 00	17 00
Do ....do.....scows	5 00	½ price.	5 00	....	5 00
Do ....do.....tug	....	....	10 00	....	6 00
Ship carpenters ....per hour	37½	35	35	35	35
Ship smiths ....do	37½	35	38	40	35
Ship caulkers ....do	36	35	33	35	35
Ship scrapers ....do	35	35	33	35	30
Ship laborers ....do	30	25	28	20	25

J. H. Smith & Co. accepted.

Abstract of proposals for repairs of machinery of dredges, scows, and tug.

Bids received.	Walls & Son.	H. C. Lawsbee, agent.	Hazelhurst & Co.	Murray, Clark & Co.	E. J. Cord & Co.
MATERIALS.	*No.* 1.	*No.* 2.	*No.* 3.	*No.* 4.	*No.* 5.
Boiler iron ....per pound	$0 09	(*)	$0 08½	$0 08	$0 10
Boiler rivets ....do	09	$0 12	08¼	09	10
Wrought iron ....do	07	10	07	07	06
Hammered iron ....do	10	12	08	12	10
Steel ....do	30	45	25	24	22
Iron castings ....do	(†)	05	04¾	05¼	(‡)
Brass castings ....do	30	45	30	85	40
Composition castings, per pound	30	45	30	35	38
Sheet copper ....do	38	(§)	38	45	36
Three-inch copper boiler tubes, per foot	3 50	(‖)	1 75	2 20	(¶)
LABOR.					
Boiler makers ....per hour	33	35	30	35	36
Forging and forge ....do	60	75	75	75	85
Drilling and drills ....do	50	60	40	55	60
Boring and tools ....do	60	75	75	70	80
Planing and tools ....do	60	75	50	80	65
Turning and tools ....do	60	75	50	75	70
Carpenters' work ....do	35	35	35	35	37
Pattern makers ....do	....	....	40	....	....
Fitters ....do	....	40	32	....	....
Machinists ....do	....	....	....	....	37

* Flange 10 cents, refined 8 cents.
† Loam 8 cents, machinery 4 cents.
‡ Loam 8 cents, machinery 6.
§ 15 per cent. above manufacturers' prices.
‖ 25 per cent. above manufacturers' prices.
¶ Lowest price ruling when required.

Bid of Hazlehurst & Co. accepted.

Abstract of proposals for coal.

Bids received.	Price per ton of 2,240 lbs.
1. S. M. Johnston	$5 30
2. Taylor & Chamberlain	5 80
3. Joseph Hankey	5 25

Bid of J. Hankey accepted.

Abstract of proposals for canvas roof-covering.

Bids received.	Price per square yard complete.
No. 1—J. J. Gray & Co	$0 85
No. 2—J. C. Brown	0 99
No. 3—J. C. Brown	0 97
No. 4—Tall & Edgar	1 03

Bid of J. J. Gray & Co. accepted.

Paragraph 9.—Abstract of contracts for repairs of machinery of tug and dredges—Hazlehurst & Co., contractors; prices as per schedule of proposals.

Contract for repairs of hulls and wood-work of tug, dredges, and scows—J.H. Smith & Co., contractors; prices as per proposals.

Contract for coal—J. Hankey, contractor; $5 25 per ton.

Contract for canvas roofing—J. J. Gray & Co., contractor; eighty-five cents per square yard.

IMPROVEMENT OF SUSQUEHANNA BELOW HAVRE DE GRACE, MARYLAND.

The resurvey of the area covered by this improvement showed that, under the existing regimen of the river, the decided tendency was to obliterate the effects of dredging almost entirely, and in view of this fact it has been determined to try the effect of narrowing the width of the water-way in connection with dredging.

The plan adopted (but not yet commenced) is to construct, near the point where the river expands greatly, a movable dam or breakwater to deflect the current of water toward the line of the main channel.

It is proposed to form the deflector of large rafts, chained together, each raft carrying a row of sheet-piling which will penetrate the bottom only enough to steady the rafts. The rafts in sections will be supported in position by three cribs of timber filled with stone.

The deflector is arranged with a view to its removal in the winter, and it should be replaced by a permanent work, should it prove effectual in its operations.

It is estimated that $50,000 would be required to make this improvement permanent, and this sum can be advantageously expended next year in dredging and building a permanent deflector.

The work is located in the collection district of Baltimore. Baltimore is the nearest port of entry. The work commences nearly opposite Point Concord light, and extends past Donohue's Fishing Battery light.

The coal and lumber trade between Baltimore and Philadelphia and the lumber and coal regions of the upper Susquehanna all passes through the channel to be improved.

No proposals issued as yet. No contracts executed as yet.

Respectfully submitted:

WM. P. CRAIGHILL,
Brevet Lieutenant Colonel, Major of Engineers.

Major General A. A. HUMPHREYS,
Chief of Engineers, U. S. Army, Washington, D. C.

BALTIMORE, MARYLAND, *March* 15, 1867.

GENERAL: Congress, by appropriating at its last session for the improvement of the Patapsco river below Fort McHenry $75,000, (the amount asked for one year's operations in my report on the subject to you, dated January 15, 1867,) may perhaps be considered as having thereby approved the project of improvement upon which the estimate in that report was based. This project, it will be recollected, contemplated a change in the direction, for a considerable portion of its length, of the improved main ship channel from the bay to the city of Baltimore.

The direction which it is proposed to change was adopted some fifteen years ago, at the suggestion of Brevet Brigadier General Henry Brewerton, then captain in the corps of engineers, who had given much study to the subject and had had an extensive experience in similar improvements. His plan was approved, it is supposed, by the board of engineers for such works and by the engineer department.

My opinion with reference to the propriety of the change of direction is very decided. The reasons for it have been given in previous communications.

Considering all the circumstances of the adoption of the direction of the existing "Brewerton" channel, and the extent to which the interests of the city of Baltimore—the third city on the Atlantic coast in commerce and population—are involved in the selection of the best direction for the main ship channel to its wharves, it is respectfully requested that the subject be committed to a board of engineers for examination and report before a final decision is made.

I request, also, that the consideration of the improvement of the Susquehanna river at Havre de Grace be committed to the same board.

Very respectfully, your obedient servant,

WM. P. CRAIGHILL,
Major of Engineers, Brevet Lieutenant Colonel.

Major General A. A. HUMPHREYS,
Chief of Engineers, U. S. Army.

WASHINGTON, D. C., *May* 23, 1867.

GENERAL: I have the honor to transmit herewith, in two sheets, the map of the recent survey of the Brewerton channel in the Patapsco river, and of a portion of Chesapeake bay south and east of the Seven-foot Knoll light. The ground covered by these sheets is included in Coast Survey coast chart No. 31, a copy of which was transmitted to you with my letter of this date relative to the Susquehanna river. A reference to that chart is invited, in connection with the sheets now enclosed.

The original design for the improvement of this entrance was to open a channel, one hundred and fifty feet in width and twenty-two feet in depth at mean low water, from the mouth of the basin, between Fort McHenry and the Lazaretto light, to the entrance buoy at the mouth of the Patapsco river. The channel, when completed, was intended to be in two straight lines, intersecting at a point a little below Fort Carroll.

The best water along the proposed route being in the portion above Fort Carroll, it was obviously proper to commence the work of improvement by dredging below Fort Carroll, and the dredges have thus far been worked only in that portion of the proposed channel.

It may usually be anticipated that a long straight cut like this will not be a permanent improvement. There were peculiar reasons for the expectation that this case might prove an exceptional one. These were, that the Patapsco river above Baltimore is a small stream, and when expanded into a much broader bed, as it is above Fort McHenry, the current becomes sluggish, and deposits in that part of its course the matter it may have brought down. The water is then comparatively free from such matter, and this probably accounts for the greater depth of water observable from Fort McHenry to Fort Carroll than below. Moreover the mean rise and fall of the tides is only about one foot. In consideration of the small volume of water coming down past Fort McHenry, with a velocity diminished even from what it had above, owing to a continued expansion below of the water-way, and in consideration of the small change in the water-level, owing to the small mean rise and fall of the tides, it was supposed that the water was in a condition approaching stagnation, and that hence a straight dredged channel would be permanent.

This expectation was, to a certain extent, well founded, and the dredged channel is quite fixed in condition until it crosses the line tangent to the right bank of the Susquehanna, when it becomes subject to the influences of the current of that river sweeping almost perpendicularly across it.

There is a great shoal or bar seen below Fort Carroll, the cause of which is not positively known, inasmuch as Curtis creek and Bear creek are not *streams* in the proper sense, but single short projections into the land. What is meant is that they have little or no current except what is produced by the tide. A certain amount of matter is undoubtedly brought down them on the ebb tide, and this assists in forming the great shoal below Fort Carroll; but the existence of this shoal is supposed to be chiefly due to the conflict of the currents thereabouts, caused by the tides in the bay and the two rivers, as well as by the outflow of the two latter, independent of the tides.

It is my belief that the straight cut below Fort Carroll will in time fill up, to a certain extent, if left entirely to the action of natural causes. The portion above North Point will be more permanent, but the same causes which produced that shoal will, if their operation continues unaltered, reproduce the same effect, which in this case amounts to a filling of the channel; but the process will be a slow one. The remaining portion of the straight cut below North Point will be more rapidly filled. This belief led me to see whether a better direction, and one likely to be more permanent, could not be given to this portion of the channel.

An examination of the map of the space to the south of the Brewerton channel and to the east of Seven-foot Knoll light showed that, were it not for the lumps scattered over that space, a decidedly better direction for the channel would be obtained by leaving the Brewerton cut at a point a little to the east of the Seven-foot Knoll light, running almost due south for a distance of about three miles and then turning off in a southeasterly course, passing to the north of the Belvidere shoal. The direction thus indicated is about that of the resultant current of the Patapsco and Susquehanna rivers. The principal obstructions are the lumps referred to. These are *hard*, and their remaining where they are, taken with the fact that the water is considerably deeper in their immediate vicinity, showed that everything *movable by the current* has been removed. If these lumps were taken out by dredging, it is believed a permanent and good channel would remain in this part.

I am told that it is apprehended that some of the lumps remaining near, but not in the channel, might prove dangerous to vessels which should happen from any cause to get out of the channel and strike upon them. This is a danger undoubtedly to be considered as of importance so long as a channel of but small width is provided, and that marked out only by buoys; but this danger would disappear by substituting fixed beacons, for use both day and night, and giving the channel greater width thereabouts. It is proposed to ascertain the opinion on this point of the principal ship-owners, shipmasters, and intelligent pilots of the city of Baltimore.

The advantages of this proposed direction are cheapness in first cost, permanence when once obtained, a smaller accumulation of ice in winter, and a small gain in distance.

To obviate, to a considerable extent, the danger mentioned above, it is proposed not to confine ourselves simply to the removal of lumps in the channelway, but to remove them for some distance on either side.

To keep open the straight cut from the Seven-foot Knoll light to Sparrow's Point, which cannot be improved as to direction, will require occasional dredging. There are in the possession of the engineer department, already, four dredges and appurtenances, purchased from funds appropriated some years ago by Congress for the improvement of the Patapsco river. When the funds provided from the same source fail, the machinery remains available, and it would be well worth the money that would be expended if the authorities of the State and city would raise a fund sufficient to continue this machinery in action, whenever requisite to keep open a good channel to the wharves of the chief city of their State, and one of the most important on the Atlantic coast.

It is considered that 150 feet is not a sufficient width for the channel, and that it should be made 200 feet at least.

Seventy-five thousand dollars are now available for this improvement, which sum was appropriated at the last session of Congress. It is intended to apply this at once in repairing the machinery, and then working it in the channels at such points as to give, as far as practicable, a uniform width and depth throughout, which will not, of course, be the width and depth ultimately expected, as the sum available is not sufficient therefor. Estimates on this point have already been submitted to you, and through you to the Secretary of War, and to Congress.

The question which, it seems to me, should now be settled is, whether to consider the straight direction to the entrance buoy as finally adopted, or shall the change above proposed be approved. Upon this point I respectfully request an early decision.

In connection with this subject one or two other remarks may be pertinent.

There are in the possession of the authorities of the city or State several dredges, which are usually occupied in dredging in the basin, immediately about the wharves of the city, certainly above Fort McHenry. The matter dredged is that which comes from the sewers of the city, and from the small stream called Jones's Falls. This matter is deposited on the flats outside of Fort McHenry, but without much consideration as to locality, and the probable injurious effect of this deposition on the channel below.

If the general government supplies any or all of the money for improving the entrance to the harbor of Baltimore, it is directly interested in seeing that nothing is done, through ignorance or want of due consideration, to thwart its efforts in that direction. Some means should be adopted of regulating the place of the deposit referred to above. The excavated matter might be utilized as manure, or in some other way.

The great length of the straight Brewerton cut, and the consequent length of time during which vessels entering by that channel continue upon a single course, led me to think this an unusually favorable occasion for the use of fixed range beacons.

The attention of the Light-house Board being called to the matter, the suggestion was adopted, and Congress, upon application from that board, made the necessary appropriation. I was gratified, yesterday, to learn that the construction of one of the beacons is in progress, and the other will be shortly begun. This will be a most important aid to properly marking out the exact position of the Brewerton cut, and calling attention to it. The pilots of Baltimore generally decry the Brewerton cut, the real reason therefor being found in the fact that its straightness, and the consequent simplicity of its navigation when it is once known and accurately marked, would almost, if not entirely, supersede the necessity for their aid.

This is one consideration with them, and another is found in the tendency among persons of this class to cling to old things, and to look with suspicion on what is a novelty, even if an admitted improvement.

There has been some ground for complaint as to the difficulty of using the Brewerton cut—that it is necessary to have the channel, being so narrow, very carefully buoyed.

Buoys are very likely to get out of place, either by accident or by their deliberate removal by those whose interest it is to increase, in the eyes of all others than themselves, the difficulty of the navigation. Such removal of the buoys in this channel is known to me to have occurred.

This difficulty will be removed by the erection of the beacons, and the advantages of the improvement more thoroughly appreciated by the commercial community than has hitherto been the case.

Additional current observations are needed near the Seven-foot Knoll light, and these have been ordered.

It is proposed during the present season to complete the survey of the *channel* above Fort Carroll. This is necessary, as the erection of Fort Carroll itself, as well as the deposition of the matter excavated from the basin, must have had a considerable effect upon that portion of the channel, and it is very desirable to know certainly what this effect has been.

Very respectfully, general, your obedient servant,

WM. P. CRAIGHILL,
Major of Engineers, Brevet Lieutenant Colonel.

Major General A. A. HUMPHREYS,
Chief of Engineers U. S. A., Washington, D. C.

ENGINEER DEPARTMENT,
Washington, May 29, 1867.

SIR: The act of Congress making an appropriation of $75,000 for the improvement of the Patapsco river provides that "it shall be the duty of the Secretary of War to apply the sum herein appropriated for other purposes than for examinations and surveys by contract provided, however, that when, from the nature of the work to be done, the same cannot, in the judgment of the Secretary, be made the subject of contract, the necessary expenditure may be otherwise ordered."

At the time of the passage of the act there were already on hand belonging to the United States, on account of the improvement of the Patapsco river, one steam-tug, four steam-dredges, and a number of scows.

The question now arises whether this valuable machinery should be placed in the hands of contractors to be worked by them, or shall the government proceed to work it by contracting for the fuel and hiring, at the usual market rates, employés of the various grades, namely, engineers, pilots, firemen, deck hands, dipper tenders, and laborers.

The latter course would be most advantageous to the interests involved; the work is not adapted to or suitable to be done by contract.

If it is thought that the language of the act quoted must be taken literally and strictly and without qualification, growing out of the nature of the work to be done, then the boats and machinery must be put in the hands of contractors. If, however, the language be construed to mean that when, from the nature of the work to be done, the same cannot properly be made the subject of contract, it may be otherwise ordered, then the engineers and others may be hired by the officer in charge of the work.

Very respectfully, your obedient servant,

A. A. HUMPHREYS,
Brig. Gen. and Chief of Engineers, Maj. Gen. Vols.

Hon. E. M. STANTON,
Secretary of War.

As from its nature this work cannot be made the subject of contract with due regard to the public interest, the Secretary of War authorizes the Chief of Engineers to have it done otherwise.

ED. SCHRIVER, *Major General.*

WAR DEPARTMENT, *June* 6, 1867.

WASHINGTON, *June* 28, 1867.

GENERAL: All the data requisite seem now provided upon which to base a determination of the question whether the ship channel in the Patapsco river, below Fort Carroll, shall be in a straight line, or there shall be a change of driection towards the south of a point near Seven-foot knoll, as proposed some time since.

My opinion on the subject is known to you, in which I am the more confirmed by the results of the late survey. The map was transmitted to the engineer bureau with my letter of May 23, and additions to it of later current observations requested by letter of June 26.

From information received from the president of the Board of Trade of Baltimore, and from others, I believe it to be the general sentiment of those who are most deeply interested in the commercial prosperity of the city that the ship channel should turn to the southward near Seven-foot knoll.

I enclose an outline tracing showing the particular location proposed for the channel. If this tracing be placed over the proper sheet of soundings, transmitted with my letter of May 23, already referred to, the reasons for the particular location selected will become more apparent. The directions given to the lines of the channel are taken as they are, in order that in its navigation use may be made of the beacon already constructed on the Seven-foot knoll. It is expected that a new beacon will be erected, at the point shown on tracing, where the channel is to change its direction from a north and south line to one bearing northwest or southeast.

In entering the channel from the bay a vessel would keep upon the range of the proposed angle beacon and Seven-foot Knoll beacon until she passed the angle beacon, when she would steer due north until reaching the line of the Brewerton channel, indicated by the range beacons for that channel, about to be put in place by the light-house department. In passing out of the river a vessel would keep in the Brewerton channel until the new angle beacon was in a due southerly direction, when she would steer upon that course until she reached the angle beacon, and then she would steer upon the range of the angle beacon and the Seven-foot Knoll beacon. Vessels should always pass to the west of the new angle beacon.

I request authority to consider as adopted the change of direction of the channel proposed, and to apply the funds available in the manner to be indicated below.

It is thought that the channel should at no place have a less width than 200 feet; and estimates for such a width and a depth of 22 feet at mean low water have been submitted. The sum appropriated and available is insufficient for the completion of the improvement, which includes work between Forts Carroll and McHenry. It is proposed to apply the whole sum in hand below Fort Carroll.

The matter to be excavated from the Brewerton channel has a very different character from that of the material to be removed from the new location, being in the former a quite soft mixture of mud and sand continuously distributed; but in the latter it is a rather hard concrete of oyster shells, sand, and mud in isolated lumps. The process of dredging with the Osgood machine will answer in both cases.

Operations have been delayed by causes beyond my control. In consideration of this fact, and influenced by the desire, since the proper plan of improvement now seems clear, to produce as great a result in the remainder of the present season as the available means will allow, I propose to employ in the new part of the channel, in the manner authorized by the Secretary of War, that is, by days-work, the dredges belonging to the United States on account of this improvement, and to engage other dredges, if possible, to work, under contract, in the Brewerton channel by the cubic yard. This, it is considered, will be the most advantageous distribution of the owned and hired dredges.

The hard lumps are a much more dangerous obstruction than soft mud, and it is therefore proposed to give the channel through them a greater width than 200 feet, but to confine the work of this season in the Brewerton channel to clearing out to a width of 150 feet and a depth of 22 feet, and afterwards, if the means should be provided, to increase the width to 200 feet.

An early decision on the propositions of this letter is respectfully requested.

Very respectfully, your obedient servant,

WM. P. CRAIGHILL,
Major of Engineers, Brevet Lieutenant Colonel.

Major General A. A. HUMPHREYS,
Chief of Engineers U. S. A., Washington, D. C.

K 1.

UNITED STATES ENGINEERS' OFFICE,
Baltimore, Maryland, June 26, 1867.

GENERAL: In connection with this letter I request that reference be made to sheet C, transmitted with my letter of 23d ultimo, relative to the Susquehanna river improvement. That sheet is the map of the last survey of the river near Havre de Grace. The following estimate is derived from the data of that map:

To reopen the channel formerly dredged below Havre de Grace to a width of 100 feet—

Ten feet deep, 120,000 cubic yards, at 35 cents	$42,000
Nine feet deep, 90,000 cubic yards, at 35 cents	31,500
Eight feet deep, 50,000 cubic yards, at 35 cents	17,500

The price per cubic yard is that at which dredging by contract is now in progress at that place.

The money appropriated by Congress and now available for the improvement of this river is $26,400.

The estimate (see my letter of 4th instant) for a movable deflector amounted to $20,200, of which $3,600 were to be applied to three fixed cribs as points of support.

If the available funds are applied to dredging by contract a channel in the old direction, and only eight feet deep, there would remain but $9,000 for the deflector, which would be insufficient to make it properly.

Sheet C shows a considerable filling at the lower end of upper cut. Representations have lately been made to me that the commercial interests of the community are seriously impaired by this obstruction. There is a strong desire that immediate steps be taken to remove it. I propose to open at once, by contract, a channel, shown by the dotted red lines on enclosed tracing, 100 feet wide and eight feet deep. This will, I am informed, give relief to the immediate and pressing wants of the community. The cost of the work will be $3,000. I ask authority to undertake this at once.

The Coast Survey party at my disposal have finished what is now required in connection with the Patapsco river improvement, and will immediately proceed with the additional current observations needed near Havre de Grace in the Susquehanna, and with the additional soundings requisite to complete sheet C to the new railroad bridge.

I request authority to proceed as soon as practicable with the execution of the movable jetty, for plans and estimates of which see letters of 23d ultimo and June 4. I propose to locate first one or more of the cribs, the precise position to be determined after the completion of the current observations. The construction of the movable part of the deflector would be commenced later, to be extended this season as far as the means available will permit. It will be understood that a part of the plan is to swing the deflector out of the way of danger from ice when that danger threatens, restoring it to its place in the early spring when the ice has cleared out of the river.

In addition to the dredging recommended in this communication as of immediate importance, it will probably be desirable to dredge more at a later period near the same point, and also near the lower half of the lower cut. This should also be done by contract and possibly during this season.

Last year, before the passage of the law making appropriations for the improvement of the Patapsco and Susquehanna rivers, the Chief of Engineers authorized me to draw for $20,000 from the general appropriation for harbors on the Atlantic coast, to be divided according to my discretion equitably between the improvements.

A large portion of this sum was consumed in repairs of the machinery belonging to the Patapsco river, with the intention of dividing the remainder equally between the two places. When the special appropriations were made, the smaller sum of $5,200 was provided for the Patapsco, the more important object, and the larger sum of $26,400 for the Susquehanna, the less important object. I then proposed to the engineer department to expend on the Patapsco last season the entire balance from the allotment from the general appropriation, and in addition the small special appropriation, and this season to spend its special appropriation on the Susquehanna, using, however, the machinery belonging to the Patapsco, but repaired from funds derived from the general appropriation.

This proposal was approved and would have been carried out, but the conditions of the case were again changed by the appropriation at the last session of Congress of $75,000 for the Patapsco, and nothing for the Susquehanna, which required the machinery belonging to the Patapsco to be retained in its own improvement, and left the Susquehanna to be otherwise provided for.

In consideration of the facts stated above, and that the funds available for the Susquehanna may not suffice for what it is very desirable to do for it, I propose that the special appropriation for the Patapsco now return to the general appropriation for harbors on the Atlantic, $10,000, and that that sum be held in reserve to be applied to the Susquehanna upon the exhaustion of the present special appropriation, and in the event of no additional appropriation being made therefor at the next session of Congress.

This arrangement I consider entirely equitable, and I request your approval of it.

Very respectfully, your obedient servant,

WM. P. CRAIGHILL,
Major of Engineers, Brevet Lieutenant Colonel.

Major General A. A. HUMPHREYS,
Chief of Engineers U. S. A., Washington, D. C.

WASHINGTON, D. C., *June* 4, 1867.

GENERAL: I transmit herewith the estimates promised in my letter of 23d ultimo relative to the Susquehanna river, with a sketch of the proposed floating dam.

The sketch exhibits merely the idea. If that is approved the details will be elaborated.

It seems to me as settled that dredging alone, unless continuous, is not the expedient to be resorted to for the improvement of the navigation there. The continual use of dredges cannot now be expected.

The probability seems great of a favorable result from the use of one or more jettees. If the system be adopted, the first to be erected (and that would probably be all that would be needed) would be about in the position indicated in my letter of 23d ultimo, referred to above. If it be decided to construct a jettee in that position, there are several objections to making it of stone alone, or of wooden cribs filled. The first and a very serious one is the expense. There is certainly not money enough available at this time for such a structure. Another objection is, that if built it might be found to act disadvantageously, or not as well as possible, owing to a faulty location. In this event its removal would be very expensive.

If the plan of a stone structure is given up we are brought to consider the propriety of adopting a piling which must be strongly braced to resist the action of ice. There is money enough available for such a structure, but with this exception the same objections, though less in degree, may be made to it as to the stone jettee.

The floating dam has several advantages in its favor. The first cost is not great, as shown by the estimate, which is made upon a most liberal allowance as to prices. If the first position selected for it is found not to be the best, it is readily removed to another. In winter it may be entirely or partially removed, if necessary, to avoid danger to it from the ice. If found to fail utterly of the expected effect, the materials may be sold for nearly their first cost. If found to succeed, and it is desired to replace it by a fixed structure of wood alone, or of wood and stone combined, its materials themselves, or the proceeds of their sale, may be applied to the new work.

It is not considered necessary, and it may be disadvantageous, that the contact between the movable uprights shall be perfect, and that they shall all, or nearly all, touch the bottom. Some of them, however, should reach the bottom and penetrate to a small depth, in order to assist in steadying the rafts against the tendency to be partly submerged or moved out of place under the action of the currents. It may be necessary or advantageous, when considerable certainty is reached as to the best position for the jettee, to drive two or three piles along each raft to give fixed points of support.

With reference to this location it may be properly stated that whatever may be the effect upon the channel of any structure there, and whatever its character, no damage will result from it, considered simply as an obstruction to navigation, as it will be entirely out of the track of vessels.

It may be objected that a jettee in the proposed location, if it acts as a deflector for the downward current, will equally prevent the ascent of the flood. This is a well-founded objection, but it is not so forcible upon consideration as at first glance. In one view of the case we may disregard altogether the tidal currents, looking only to controlling the water belonging to the river, supposing it unaffected by the tides.

It is highly probable that the flood current is deflected to a very great degree at the southern edge of the large shoal at the mouth of the river, and that the flood current at the position selected for the jettee is almost inappreciable, and may be practically disregarded. If the flood is checked by the jetty there will be a proportional increase of flood in the channel, which will be at least not disadvantageous.

Additional current observations are about to be made here, the result of which will be speedily reported.

Very respectfully, your obedient servant,

WM. P. CRAIGHILL,
Major of Engineers, Bvt. Lieut. Col.

Major General A. A. HUMPHREYS,
Chief of Engineers U. S. A., Washington, D. C.

Estimate of cost of deflecting current of Susquehanna river at head of Devil's Island shoal, below Havre de Grace, Maryland, to accompany report of Brevet Lieutenant Colonel Craighill of June 4, 1867.

By rafts and sheet piling, forming floating dams, anchored to stone cribs, three (3) cribs, at $1,200 each	$3,600 00
Fifty-two (52) rafts, at $300	15,600 00
Iron, superintendence, &c	1,000 00
Total cost	20,200 00

By continuous piling, with back row and braces, ninety thousand (90,000) feet of piling and braces, at 25 cents per running foot.	$22,500 00
Prices used for above—	
Lumber, per 1,000 feet, board measure	25 00
Iron and labor, per cent. of value of lumber	30
Piles, runnning foot	15
Piles, driving, each, (can probably be done for from $1 75 to $2 per pile)	3 00
Stone, per cubic yard, delivered in cribs	1 50

ENGINEER OFFICE, HARBOR DEFENCES,
Baltimore, June 4, 1867.

WASHINGTON, D. C., *May* 23, 1867.

GENERAL: In compliance with your oral directions I have the honor to submit the following report with reference to the improvement of the Susquehanna river at Havre de Grace.

Accompanying this report are three sheets, as follows, viz: Coast Survey coast chart No. 31, marked A; tracing of survey of 1846, marked B; tracing of survey of 1867, marked C.

Upon B and C are marked in red the straight cuts dredged out seven years ago to a width of 100 feet and a depth of 10 feet, which was in conformity to the project of the board of engineers. B shows the channel and shoals as they were in 1846, fourteen years before the completion of the dredging. C shows them as they were in 1867, seven years after the completion of the dredging.

The general position and character of the channel and the shoals were not greatly different in 1846 and 1867; that is to say, the variations are probably not materially greater in the interval of twenty years than may occur in the same year, as the shoals are subject to changes from the action of freshets and ice.

The conclusion to be derived from the facts before us is, that if a channel in this location be dredged out to a given depth and width, and then left untouched for several years, it will be filled up to such an extent as to be virtually in the same condition as before the improvement was attempted.

It is then clear that a permanent improvement requires some plan different from that which has been executed thus far. If the cut formerly made is to be reopened, something is needed to keep it open. This may be done by constant attention, and dredging whenever a filling-up is seen to have begun. For this purpose machinery must be procured, and the means should be always available to set it in motion whenever required. It is not probable that these conditions will be satisfied, if at all, for many years to come, when the population of this section of the country may have become so dense and the importance of the navigation of the Susquehanna so great as to justify the continuous expenditure of the money requisite to keep this channel open.

In my last annual report the opinion was expressed that it might be found advantageous, after more study of this subject founded upon a survey which was necessary, to improve the shore channel by dredging in the spots where it was needed and cutting through the shoal on line A A, sheet B.

A comparison of the maps of 1846 and 1867 leads me to abandon this idea.

An examination of sheet A shows that the bed of the Susquehanna river for a number of miles above the Havre de Grace light is about one mile in width. At that point there is a sudden and very great expansion of the water-ways, so that the width of the opening is over five miles, if measured on a straight line drawn from near Carpenter's Point through the fishing battery light.

The effect of this sudden expansion is the formation of extensive shoals and of a channel with a diminished depth. A striking feature is the great shoal immediately in prolongation of the narrower portion of the river. This shoal may be supposed to have been formed in course of time by matter brought down the river and there deposited, owing to the diminution of the velocity of the current consequent upon the sudden and great expansion of the water-way.

The volume of water coming down now impinges against this great shoal. The effect of this impact is seen in the deep sack formed in the edge of the shoal. A considerable portion of the water of the river spreads over the shoal and passes out eventually between Sandy and Turkey Points. The navigable channel from the head of Spesutie island to near the town of Havre de Grace, receives only the water which is deflected from the great shoal, and, indeed, only a part of that, as another portion is spread over the shoal to the westward of the channel.

If the water which does not now pass through the channel below Havre de Grace could be made to pass through it, there would be strong ground for expecting that the channel would be correspondingly and permanently improved.

To effect this object a deflector seems an obvious expedient, so placed and constructed as to catch the water now lost on the shoal, (which is itself a partial deflector,) and with such a direction that the desired deflection shall be gradual and complete.

I think the proper direction for the deflector is a line about parallel to the western edge of the great shoal near its northern portion.

The proper position for the deflector is probably a little to the eastward of the western edge of the shoal, and it should extend across the deep sack in the shoal, at or near its mouth. The line of it would be about *b c b*, sheet B.

As it is always impossible to foresee the effect of any interference with the natural regimen of a water-course, I should prefer that the deflector be temporary and removable if found to act disadvantageously, or when endangered by ice, and my wish was, and is, to devise a floating structure which would act as a deflector when anchored in position.

It is difficult, however, to arrange such a structure on account of the considerable depth to which it should sink in order to be effectual. I propose, therefore, a more fixed arrangement, which is, to sink three cribs filled with stone at the points *b*, *c*, and *b*, and connect them by a single row of piles driven very nearly, though not quite, in contact with each other, and connected at the top by a cap-piece.

The effect of this structure should be very carefully observed. It may be found necessary to extend it towards the north or south, or to remove a portion of it. It is not improbable that it may be found expedient to erect a jettee also on the Havre de Grace side to give a better direction to the water, which now spreads over the shoal westward of the channel.

An estimate is in course of preparation of the cost of such a jettee as is proposed above. If found to do what is expected of it, there should be formed a solid stone jettee on the line of the proposed piling, for which an estimate will be submitted.

There will also be prepared an estimate of a floating substitute for the piling,

It would be desirable, simultaneously with the construction of the jettee, or antecedent thereto, to dredge through the shoal which has formed at the lower end of the upper cut, and to widen the channel about the lower half of the lower cut. An estimate will be prepared of the cost of reopening the old cuts to the depth of ten and the width of one hundred feet.

Some additional current observations are requsite in order to decide definitely the precise position for the proposed jettee. These have been directed.

There is no pressure from any quarter for rapid progress in the work of improvement at this point, and it would seem advantageous, therefore, to proceed deliberately with it.

Very respectfully, your obedient servant,

W. P. CRAIGHILL,
Major of Engineers, Brevet Lieutenant Colonel.

Major General A. A. HUMPHREYS,
Chief of Engineers, U. S. A., Washington, D. C.

APPENDIX L.

U. S. ENGINEER'S OFFICE, PHILADELPHIA, PA.,
September 11, 1867.

SIR: In accordance with the requirements of circulars Nos. 11 and 24, engineer department, dated respectively the 10th of June and 29th of August, 1867, I have the honor to transmit herewith annual reports of the progress made in the following river and harbor improvements and surveys in my charge, together with the necessary abstracts of proposals, and of contracts, &c., relating thereto, viz: Delaware breakwater, Delaware bay; improving harbor, &c., at Marcus Hook, Delaware river; improving harbor, &c., at Chester, Delaware river; survey at Reedy island, Delaware river; survey at Liston's Tree point, Delaware. In all fifteen papers.

I would take this opportunity of calling attention to the unhappy effect of some of the provisions of the act of Congress making appropriations for the above works. By law, all power is taken from an officer to reject, after due advertisement, a bid merely because it is extortionate. If the lowest bidder be a responsible man, the law *requires* a contract to be made with him, though he offers to furnish the articles or labor at a thousand fold its market price. If an attempt is made to regulate bids, by stating in the advertisement that unreasonable bids will be rejected, the bidder quietly remarks, "I have read the law," and avails himself in his bids of the particular information gained by poring over congressional publications, to the detriment of the public interest. This provision of the law offers a premium to contractors to enter into combination to force prices to such a point as they may choose to fix upon, after obtaining the control of the market in regard to certain articles. Such a combination in one instance has already caused much difficulty and delay in the prosecution of certain work at Marcus Hook, and will give much more, perhaps, ultimately rendering a suspension of operations for weeks or months necessary.

The proviso requiring separate contracts to be made for each class of materials or labor for each work, instead of a single contract embracing all the means and appliances requisite for a proper prosecution of the work to its entire completion, is producing all the trouble, confusion, and dissatisfaction that were anticipated by the department when endeavoring to have the proviso modified last year. It has resulted in parcelling out to four or five distinct individuals what should have been under the control of one, and rendering it almost impracticable for the different parties to work harmoniously and to the greatest advantage for the interests of the United States. They are loud in their denunciation of the absurdity of the provision, judging from their experience as practical men, as experts in matters of construction.

In the works under my charge it has prevented some of the most reliable men from making bids. When informed of the provisions of the law, seeing at once the endless complication which might arise, the constant jarring and quarreling between the different parties, and loss to which they themselves might be subjected through the delay or failure of another party, upon whose work their own might depend, they refuse to look at drawings, specifications, or anything else; stated under such conditions they did not wish to know anything more; "they would not touch the work with a ten-foot pole, or have anything to do with it," and they did not. By thus preventing the reception of advantageous bids, further injury to the public service results.

Under this distribution of separate contracts for labor and materials for the same work among different parties, owing to the fault of one party, heavy claims for damages have been made by others; the claims are just, but the aggressor refuses to pay them, and how they are to be paid under the law remains to be settled.

If it was desired to cause work to be done at great expense, in the most unsatisfactory manner, and to assist in further demoralization of contractors—if, indeed, with many of them, that be practicable—a more happy set of provisions to attain these objects could hardly be devised.

I have the honor to be, sir, very respectfully, your obedient servant,

C. SEAFORTH STEWART,
Lieutenant Colonel of Engineers.

Major General A. A. HUMPHREYS,
Chief of Engineers, U. S. A., Washington, D. C.

L 1.

Report of progress made in construction of the Delaware breakwater during the year ending June 30, 1867.

It was ascertained, after an examination of this work on the 9th of August, 1866, that preparations could not be made and materials procured in time to accomplish any work during that year.

On the 7th of January, 1867, proposals by advertisement were invited for furnishing as much stone for continuing this work as was supposed could be advantageously received during the working season; and on the 31st of the same month proposals, in like manner, were invited for putting the stone to be furnished in position.

Three sets of bids for material were sent in and six for labor. Contracts were accordingly entered into with the lowest responsible bidders.

On the 23d of May the placing of stones in position on the breakwater was begun.

Through miscalculation as to means to be employed, the contractor for labor, although thoroughly forewarned on all such points, did not put up machinery of suitable character and strength for the work to be done. Vessels, therefore, could not be unloaded as rapidly as they should have been, nor as fast as through his representations the masters had been led to anticipate. Some vessels before discharging were kept waiting for weeks. Hence have arisen claims for demurrage as yet unpaid by the contractor for labor, from whom it is justly due.

Owing to the machinery and the inexperience of the hands employed at the labor, very little progress in the construction had been made up to the 30th of June, 1867—the close of the fiscal year.

In all, at that date, about 1,200 tons of stone had been received and put in position, completing to the full height of superstructure 115 feet in length. The whole length completed is about 2,000 feet, and some 560 feet in length remain to be raised to the proper height.

No work has been done at the ice-breaker; as soon as it can be completed a crane will be placed there, but the principal effect will be directed to complete, so far as practicable, in the first place, the breakwater proper, its present base.

Expenditures to June 30, 1867.

Advertising, stationery, &c	$527 74
Contractors for stone furnished	3,235 32
Services of United States inspectors, &c	490 29
Total to June 30, 1867	4,253 35
In hands of agent July 1, 1867	$23,546 65
In treasury July 1, 1867, available for the year ending June 30, 1868	189,603 70
Total available for year ending June 30, 1868	213,150 35

This sum will probably complete the works on their present bases.

Amount that can probably be profitably expended during the year ending June 30, 1868, $100,000.

The breakwater is located in the collection district of Delaware. The nearest port of entry is Wilmington. There is a light-house upon the breakwater and another upon Cape Henlopen. Fort Delaware is the nearest fort. The amount of revenue collected at Wilmington during the fiscal year ending June 30, 1867, is $41,733 96.

It is estimated that during the past year upwards of 30,000 vessels have passed in and out of Delaware bay and by these works. Many of these vessels have taken shelter in the artificial harbor.

The following table, taken from such imperfect records as have been kept from time to time since the breakwater was raised above the surface of the water, gives the number of vessels of each class sheltered behind that work during the different periods therein specified:

Years.	Ships.	Barks.	Brigs.	Schooners	Sloops.	Pilot boats	Steamers.	Total.
1833 *a*	22	....	178	372	167	127	....	866
1834 *b*	48	....	315	667	303	411	....	1, 744
1835	133	....	569	1, 719	461	644	....	3, 526
1836	301	....	1, 027	2, 719	620	767	....	5, 434
1837	227	....	478	2, 777	629	732	....	4, 843
1838	165	....	732	3, 191	765	685	....	5, 538
1839	165	....	504	3, 561	734	697	....	5, 661
1840 *c*	172	....	279	1, 909	308	371	....	3, 039
1841 *d*	111	....	902	3, 916	590	483	....	6, 002
1842	107	....	1, 060	5, 335	802	744	....	8, 098
1843	103	....	841	4, 981	1, 167	792	....	7, 884
1844	231	....	969	5, 767	854	744	....	8, 595
1845	265	....	1, 042	5, 446	597	776	....	8, 126
1846	258	....	1, 625	6, 711	614	781	....	9, 989
1847	342	....	1, 937	7, 742	358	874	....	11, 253
1848	340	....	1, 457	6, 037	374	918	....	9, 126
1849	329	....	804	3, 261	168	553	....	5, 115
1854 *e*	35	247	1, 085	5, 098	90	....	114	6, 669
1855	65	240	855	6, 808	128	....	243	8, 339
1856	116	425	1, 062	6, 125	256	....	286	8, 270
1857	79	331	981	5, 348	218	....	220	7, 177
1858 *f*	6	34	78	1, 030	174	....	38	1, 360
1862 *g*	55	239	879	8, 087	253	....	246	9, 759
1863	231	345	1, 040	7, 092	251	....	347	9, 306
1864	231	308	1, 155	7, 781	189	....	299	9, 963
1865	274	378	1, 179	6, 056	209	....	372	8, 468
1866	28	227	694	6, 747	269	....	316	8, 311
1867 *h*	97	207	490	3, 929	147	....	179	5, 049
Total	4, 536	2, 981	24, 217	130, 242	11, 725	11, 149	2, 660	187, 510

a From Sept. 1, inclusive.
b July 1 to Oct. 17 not recorded.
c To June 3, inclusive.
d From May 1.
e From April 1, inclusive.
f To March 31, inclusive.
g From Feb, 1, inclusive.
h To June 30, inclusive.

It is thus seen that 187,510 days shelter have been afforded to vessels of every class. Upon an average for each recorded day of these 28 years, 21 vessels have been at anchor in this harbor.

Abstracts of proposals of contracts for the work and for each class of materials and labor therefor are transmitted herewith.

It is thought that probably, at intervals of ten years, or thereabouts, the damages to the work caused by ice and storms may require an appropriation of about $15,000 for repairs.

Abstract of contracts for Delaware breakwater: Contractors, Henry Barker and J. R. Bodwell, stone; William H. Miller, labor.

Abstract of contracts for each class of materials and labor for Delaware breakwater: Contractors, Henry Barker and J. R. Bodwell, stone, at $4 73 per ton; William H. Miller, labor, at $1 22 per ton.

Respectfully submitted:

C. SEAFORTH STEWART,
Lieutenant Colonel of Engineers.

Abstract of proposals for Delaware breakwater.

Name of bidder.	Per ton for stone.		Labor, rate per ton.	Remarks — character of stone.
	One-fourth to two tons.	Two tons and upwards.		
John C. Leiper and Richardson Shoemaker	$4 00	$5 25	....	Gneiss.
William H. Groves	2 70	2 70	$1 30	Do.
Henry Barker and J. R. Bodwell	4 73	4 73	1 97	Granite and gneiss.
Cornelius and Charles F. Kennedy	....	....	1 25	
E. D. Hitchens, E. J. Morris, G. Chambers, D. A. Marshall, and C. Burton	....	....	1 69	
William H. Miller	....	....	1 22	
James E. Neal	....	....	1 37	

NOTE.—The proposals of William H. Groves were rejected, he not being considered, under the circumstances of the case, a responsible bidder.

C. SEAFORTH STEWART,
Lieutenant Colonel of Engineers.

L 2.

Report of progress made in repairs of government piers, wharves, and landings, and in improving harbor at Marcus Hook, on Delaware river, Pennsylvania, during the year ending June 30, 1867.

Having on the 21st of July, 1866, been charged by the department with the prosecution of these repairs, after an examination of the piers and harbor early in August following, a report of the results of this examination was made, and on the 20th of September, in accordance with the act of Congress relating to the appropriation, proposals were invited by advertising for making the required repairs.

But one person made bids, and, as stated in my report of last year, owing to delay in perfecting the bids and to the insufficiency of the appropriation to make the repairs needed, the proposals were not accepted, and further operations were postponed until the present season.

During the winter session of Congress, in consequence of reports and estimates submitted, an additional appropriation was made for repairs and also for improving the harbor by the addition of four new piers, in accordance with plan also submitted.

On the 15th of May, 1867, proposals for repairs of old piers, wharves, &c., were invited by advertisement, and on the 22d of same month for furnishing materials and labor for the construction of the four new piers to be placed on the prolongation of the old.

There were three bidders for the repairs, and contracts for each class of labor and materials were entered into with the only bidder whose proposals conformed to the requirements of the act of Congress, and work under these contracts was to commence by the 5th of July, 1867. No work therefore had actually been done on these repairs at the termination of the fiscal year ending June 30, 1867.

For materials and construction of the four new piers there were in all twelve sets of bidders. Four sets of contracts were in process of preparation with the lowest responsible bidders at the close of the fiscal year, and under these work was to be commenced early in July, the first month of the fiscal year for which the appropriation for the new piers was made.

The expenditures during the year have been as follows, viz:

Advertising for proposals	$828 18
Stationery and other contingencies	9 80
Total to June 30, 1867	837 98
In hands of agent, July 1, 1867	$4,212 02
In treasury, July 1, 1867	93,950 00
Available for year ending June 30, 1868	98,162 02
Probable amount required for the entire and permanent completion of the work	$98,162 02

This amount can be profitably expended during the fiscal year ending June 30, 1868, and nothing further is asked for to complete the work.

Marcus Hook is located in the collection district of Philadelphia; the nearest port of entry, light-house, and fort are, respectively, Wilmington, Delaware, Christiana light, and Fort Mifflin.

The amount of revenue received at Wilmington during the past fiscal year is $41,733 96.

Before completion of the work it will be of benefit to commerce and navigation so far as to afford occasionally a convenient ice harbor to vessels passing up and down the Delaware when ice is running therein heavily. The works may also aid in building up local commerce.

Abstracts of proposals, of contracts for the work, and of contracts for each class of materials or labor for the work, are transmitted herewith.

For a few years after completion of the work it is believed no large expenditure will be required unless for repairs caused by unforeseen accidents.

The probable annual expenditure may be estimated as follows, viz:

Material and labor	$100
Advertising for proposals for same	120
Contingencies	20
Total per year for ten years	240

At the expiration of about ten years the wood-work of piers, wharves, and landings now to be repaired may require renewing to the extent of probably $5,000.

Abstract of contracts for improving harbor at Marcus Hook, Pennsylvania.

Repair of piers:

William H. Rotan, for all timber, iron, and labor.

Four new piers:

Abraham P. Eyre, hemlock timber and labor on same.
John C. Leiper, for all stone.
Robert Crane and John Keaveny, for labor on stone.
James R. Grant, for all iron.

C. SEAFORTH STEWART,
Lieutenant Colonel of Engineers.

Abstract of contracts for each class of materials and labor for improving harbor at Marcus Hook, Pennsylvania.

Repairs of piers:

William H. Rotan—Hemlock wharf timber, 14 cents per foot, face; hemlock piles, ties, and drag logs, 7 cents per foot, lineal; white pine wharf timber, cap logs and caps, 30 cents per foot, face; white pine bridge timber and plank, 4 cents per foot, board measure; oak fenders, 5½ cents per foot, board measure; mooring posts, 4 cents per foot, board measure; iron bolts, 7 cents per pound; corner plates and spikes, 10 cents per pound; screw bolts, 14 cents per pound; ring bolts, 16 cents per pound; labor on wharf timber, 14 cents per foot; labor on piles, 14 cents per foot, lineal; labor on plank, mooring posts, fenders, &c., 1½ cent per foot, board measure.

Four new piers:

Abraham P. Eyre—Hemlock wharf timber, 13¼ cents per foot, face; labor on wharf timber, 5 cents per foot, face,

John C. Leiper—Hammered facing stone, 79 cents per foot, cubic; paving stone, 73 cents per foot, cubic; rubble backing stone, $3 per perch; rubble filling stone, $1 40 per perch,

Robert Crane and John Keaveny—Labor on hammered facing stone, $3 per yard; labor on paving stone, $2 50 per yard; labor on rubble backing stone, $2 per perch; labor on rubble filling stone, $1 per perch.

James R. Grant—Iron bolts, 6½ cents per pound; screw bolts, 10 cents per pound.

C. SEAFORTH STEWART,
Lieutenant Colonel of Engineers.

Abstract of proposals for repairs at Marcus Hook, Pennsylvania.

No. 1. A. P. & Edwin S. Eyre—White pine cap logs, 32 cents per foot, face, square measure; white pine bridge timber, $30 per 1,000 feet; white pine mooring posts, $14 each; white oak fenders, $48 per 1,000 feet; hemlock square timber, 14 cents per foot, face; hemlock round and piling, 8 cents per foot, lineal; white oak timber for piling, 14 cents per foot, lineal; stringers or side of bridging, 30 cents per foot, lineal; digging out, removing, piling, &c., 14 cents per foot; furnishing and laying white pine bridge plank, $50 per 1,000 feet; driving piles, $5 each; putting on fenders, preparing for capping, $1 50 each; iron work, 8 cents per pound.

No. 2. Milo W. Locke—White pine timber, 30 cents per foot, lineal; hemlock timber, including piles, 16 cents per foot, lineal; white oak timber, $60 per 1,000 feet, board measure; iron work, 8 cents per pound; on white pine, 10 cents per foot, lineal; on hemlock cribs, 6 cents per foot, lineal; driving piles, 15 cents per foot, lineal; stone, $2 50 per perch; removing old work, &c, $1,000.

No. 3. W. H. Rotan—Hemlock piles, ties, and drag logs, 7 cents per foot, lineal; hemlock wharf timber, 14 cents per foot, face; pine wharf timber, 30 cents per foot, face; pine caps and cap logs, 30 cents per foot, face; pine bridge timber, 4 cents per foot, board measure; pine plank, 4 cents per foot, board measure; oak fenders, 5½ cents per foot, board measure; mooring posts, 4 cents per foot, board measure; iron bolts, 7 cents per pound; iron corner plates, with nails, 10 cents per pound; iron screw bolts, 14 cents per pound; iron ring bolts, 16 cents per pound; laying wharf timber, 14 cents per foot, lineal; driving piles, removing old work, filling up, &c., 14 cents per foot, lineal; bridge work, planking, putting on fenders, mooring posts, and all sawed timber, 1½ cent per foot, board measure.

The proposals of William H. Rotan, being more nearly in conformity with the requirements of law and the lowest in the aggregate, were accepted.

C. SEAFORTH STEWART,
Lieutenant Colonel of Engineers.

Abstract of proposals for new piers at Marcus Hook, Pennsylvania.

Reaney, Son & Co.—Iron bolts, 7 cents per pound.

James R. Grant—Iron bolts, 6½ cents per pound; screw bolts, 10 cents per pound.

John R McNeil—Rubble filling, $1 47½ per perch.

Edward J. Lanman—Rubble filling, $1 95 per perch; rubble backing, $5 per perch; hammered facing stone and paving stone, $9,417 for each pier.

George W. Smith—Hemlock timber, 16¾ cents per foot, face.

Robert Crane and John Keaveny—Hammered facing stone, $24 per cubic yard; paving stone, $19 per cubic yard; rubble backing, $5 50 per perch; rubble filling, $3 per perch; hemlock timber, 17 cents per foot, face; iron bolts, 10 cents per pound; labor on hammered facing stone, $3 per yard; on paving stone, $2 50 per yard; on rubble backing, $2 per perch; on rubble filling, $1 per perch; on hemlock timber, 15 cents per foot, face.

John Stewart, jr., and John S. Stevens—Iron bolts, 7 cents per pound.

William H. Rotan—Hemlock timber, 16 cents per foot, face; iron bolts, 7 cents per pound; labor on hemlock timber, 5 cents per foot, face.

A. P. Eyre—Hemlock timber, 13½ cents per foot, face; iron bolts, 7½ cents per pound; labor on hemlock timber, 5 cents per foot, face.

Henry Barker and J. R. Bodwell—Hammered facing stone, $1 20 per cubic foot; paving stone, $1 20 per cubic foot; rubble backing, $4 per perch; rubble filling, $2 per perch; labor on hammered facing stone, $6 per cubic yard; on rubble backing, $1 50 per perch; on rubble filling, 25 cents per perch.

John C. Leiper—Hammered facing stone, 79 cents per cubic foot; paving stone, 73 cents per cubic foot; rubble backing, $3 per perch; rubble filling, $1 40 per perch.

John Honan—Labor on hammered facing stone, $4 75 per yard; on paving stone, $4 75 per yard; on rubble backing, $2 per yard.

C. SEAFORTH STEWART,
Lieutenant Colonel of Engineers.

L 3.

Report of progress made in improving harbor at Chester, Pennsylvania, during the year ending June 30, 1867.

Congress having, during the last winter session, made an appropriation for improving Chester harbor by repairing the government piers, &c., and the department having charged me with the prosecution of these repairs, proposals therefore were invited by advertisement on the 29th of May, 1867.

Six sets of proposals were received, and those of the lowest responsible bidders accepted.

It being about the close of the fiscal year, preparations were made to enter into the necessary contracts, that work might be commenced as soon as practicable after the beginning of the new fiscal year, for which the new appropriation had been made.

Proposals for repairs to the causeway connected with the lower pier had not been invited in May, as it was believed this work might be done to greater advantage at a later day. No work upon repair had therefore been begun at the close of the year ending June 30, 1867. Expenditures for that year have been as follows, viz:

Advertising for proposals	$294 73
Stationery	1 85
Total to June 30, 1867	296 58
Amount available for the year ending June 30, 1868	10,703 42

This sum will probably be sufficient for the completion of the contemplated repairs, and can be profitably expended during the fiscal year ending June 30, 1868. No further appropriation is asked for.

Chester is located in the collection district of Philadelphia. That city is the nearest port of entry. Fort Mifflin is the nearest fort, and the nearest lighthouse is Fort Mifflin light. The amount of revenue collected at Philadelphia during the fiscal year ending June 30, 1867, is $8,845,772 43.

It is reported that at one time during the past winter about seven sea-going steamers, two ships, five or six barks, and some thirty-five small crafts were ice-bound at Chester.

Since October, 1866, from incomplete records, it would seem that at least eleven steamers, eight barks, nine brigs, and many smaller vessels have arrived there, besides the steamboats touching daily on their up and down trips.

Inasmuch as private wharves have been built in what was once the harbor between the government piers, and may apparently be extended at will, having already greatly diminished the capacity of the harbor, as other piers and wharves have been built above and below, and it is intended, by private individuals, to make like and extensive arrangements for the accommodation of vessels in landing and receiving freight, and to protect them from ice during the winter months, it would seem it is no longer necessary for the United States to be at the expense of keeping these piers in repair for the sake of what was once the only shelter for vessels, the so-called harbor of Chester, and that it would be more advantageous to retrocede the piers to the State of Pennsylvania, that the latter might dispose of them to private individuals, or in such other way as to it might seem best.

Abstracts of proposals, of contracts, and of contracts for each class of materials or labor for the work, are forwarded herewith.

The amount required for yearly expenditures, for casual repairs, is estimated as follows, viz:

Materials and labor	$200
Advertising for proposals for same	120
Contingencies	40
Total per year for ten years	360

After some ten years a sum of $7,000 may be necessary for renewing upper parts of piers, wharves, and bridges.

Respectfully submitted:

C. SEAFORTH STEWART.
Lieutenant Colonel of Engineers.

Abstract of contracts for improving harbor at Chester, Pennsylvania.

Name of contractor.	For what purpose.
Bartram Booth	Timber.
James R. Grant	Iron.
James Nelson	Labor.

Abstract of proposals for repairing piers at Chester, Pennsylvania.

Reaney, Son & Co.—Iron bolts, 7 cents per pound.

James Nelson—For all labor, 18 cents per foot, face.

Bartram Booth—White pine cap logs, $34 per 1,000 feet; white pine bridge timber, 30 cents per cubic foot; white pine mooring posts, 30 cents per cubic foot; white pine upper courses, 30 cents per foot, face; white pine bridge plank, $31 per 1,000 feet; oak posts and fenders, $47 50 per 1,000 feet; hemlock tie timber, 7 cents per foot.

James R. Grant—Iron bolts, 6 cents per pound; screw and ring bolts, 10 cents per pound.

W. H. Rotan—White pine wharf timber and caps, 27½ cents per superficial foot; white pine ties, 20 cents per lineal foot; hemlock square wharf timber, 15 cents per superficial foot; hemlock tie timber, 8 cents per lineal foot; oak fenders, 5 cents per foot; white pine bridge timber, $37 50 per 1,000 feet; white pine mooring posts, plank, &c., $37 50 per 1,000 feet; iron bolts, 6⅜ per pound; screw bolts, 10½ cents per pound; wrought spikes, 7 cents per pound; labor on all square timber, 1½ cent per foot; laying timber and balance of work, 12 cents per foot.

A. P. Eyre—White pine side and caps, 31 cents per foot, face; white pine bridge timber, $32 per 1,000 feet; white pine stringers, 32 cents per lineal foot; white pine plank, $37 per 1,000 feet; white pine mooring posts, $30 per 1,000 feet; hemlock tie timber, 7 cents per lineal foot; oak fenders, $45 per 1,000 feet; labor on timber, 13½ cents per foot, face; placing sleepers for bridges, $4 per 1,000 feet; bridge covering, $6 per 1,000 feet; placing and securing mooring posts, $10 per 1,000 feet; for linear work, 10 cents per foot; putting on of fenders, $15 per 1,000 feet.

C. SEAFORTH STEWART,
Lieutenant Colonel of Engineers.

Abstract of contracts for each class of materials and of labor for improving harbor at Chester, Pennsylvania.

Bartram Booth—White pine cap logs, $34 per 1,000 feet, board measure; white pine bridge timber and mooring posts, 30 cents per cubic foot; white pine wharf timber, 30 cents per foot, face; white pine bridge plank, $31 per 1,000 feet, board measure; hemlock tie timber, 7 cents per foot, lineal; white oak posts and fenders, $47 50 per 1,000 feet, board measure.

James R. Grant—Iron bolts, 6 cents per pound; corner plates, spikes, screws, and ring bolts, 10 cents per pound.

James Nelson—For all labor, 18 cents per foot face of wharf and pier work.

C. SEAFORTH STEWART,
Lieutenant Colonel of Engineers.

L 4.

Report of progress made in survey at Reedy island during the year ending June 30, 1867.

This survey was commenced by R. M. Bache, Assistant United States Coast Survey, on the 1st of May, 1867. The stormy, rainy weather prevalent during the months of May and June interfered with its progress greatly. At the close of the fiscal year, on June 30, 1867, the field-work had not been completed.

It will be some time before the results of the survey can be ascertained and be made available to determine what plan shall be adopted and the expenditures necessary under such plan.

The expenditure on the survey on June 30, 1867, had been as follows, viz:

Services of hired men	$391 95
Subsistence	78 00
Signals and contingencies	36 56
Total to June 30, 1867	506 51

Probably as much more will be required to complete the survey.

Reedy island is in the collection district of Delaware. The nearest port of entry is Wilmington, Delaware.

There is a light upon the island—Reedy island light.

Fort Delaware is the nearest fort.

The amount of revenue collected at Wilmington during the fiscal year ending June 30, 1867, is $41,733 96.

Respectfully submitted:

C. SEAFORTH STEWART,
Lieutenant Colonel of Engineers.

L 5.

Progress made in survey at Liston's Tree Point, Delaware, during the year ending June 30, 1867.

An officer of the Coast Survey has been detailed for this work upon the completion of the survey at Reedy island, upon which he was engaged at the close of the fiscal year ending June 30, 1867.

To make this survey may require an expenditure of $1,000. This will be expended during the fiscal year ending June 30, 1868.

Liston's Tree Point is located in the collection district of Delaware. The nearest port of entry is Wilmington. Bombay Hook light-house is the nearest light; Fort Delaware the nearest fort.

The amount of revenue collected at Wilmington, Delaware, during the fiscal year ending June 30, 1867, is $41,733 96.

Respectfully submitted:

C. SEAFORTH STEWART,
Lieutenant Colonel of Engineers.

APPENDIX M.

NEW YORK, *August* 6, 1867.

GENERAL: I have the honor to submit the following report of operations upon the improvement of the Hudson river during the year ending June 30, 1867:

By letter of August 6, 1866, the department was furnished with a report of the condition of the Hudson river, and of the works erected for its improvement by the United States engineers and by the State commissioners, from Troy to New Baltimore.

The works erected by the United States from 1834 to 1843, consisting of the Overslaugh dike below, and the Port Schuyler dike above, Albany, were found to need extensive repairs, and to this purpose it was proposed to devote the whole sum of $83,000 then available. Brevet Lieutenant Colonel John M. Wilson, captain of engineers, having reported to me September 6, as assistant upon the improvement of the Hudson river, repaired to Albany, furnished with the necessary instructions to undertake the repairs of the United States dikes above and below Albany. Under his efficient supervision repairs have been vigorously pushed during the year.

Notwithstanding the lateness of the season at which work was commenced, and the unusual number of freshets which postponed active operations of this season nearly to June, considerable progress has been made.

The repairs of the dikes consisted in repaving slopes with large stone laid by hand, in restoring the original cross-section of the dike by a filling of stone, and by repaving the surface; and when the destruction of the dike had gone too far, in rebuilding it, using the construction known as the half-dike.

November 9, 1866, a full report and estimates for the improvement of the Hudson river, made as complete as possible from information compiled from former surveys and reports, was rendered to the department.

Under this report a further appropriation of $305,188 was granted by Congress.

A board of engineers was convened at Albany on May 14, 1867, and the system described in the report of November 9 substantially indorsed.

A survey of the river near New Baltimore, and also at Cuyler's island, above Albany, was made in May and June, for the express object of locating correctly the works of improvement required at those localities. These surveys will hereafter form portions of the general survey of the river.

Tide-gauges have been set at Troy, Castleton, Albany, and New Baltimore, and temporarily, for specific objects, at Coeyman's, Bogart's island, and Cuyler's island. The extension of the freshet into the month of June has prevented, for want of sufficient length of observation from the cause above assigned, a report of the tidal state of the river for the last year.

Current observations, giving velocities of surface and the set, have been made at Coeyman's, and the results transmitted, in a sketch of Barren island and the neighborhood, to the department. The surveys and examinations described have not sufficiently advanced as yet to have particular bearing upon the system of improvement adopted.

These surveys will continue until all necessary information has been obtained.

Money statement.—Appropriation of 1864.—*Repairs of harbors on the Atlantic coast.*

Amount available July 1, 1866	$33,000 00
Expended during the year	24,123 76
Balance available July 1, 1867	8,876 24

Appropriation of 1866.—*Improving the Hudson river.*

Amount available July 1, 1866	$50,000 00
Expended during the year	17,325 52
Balance available July 1, 1867	32,674 48

Examinations and surveys on the Atlantic coast.

Applied to the survey of the Hudson river:

Amount expended during the year	$651 91

Information supplied to conform to the acts of Congress making appropriations for this work:

1. Resurvey has not sufficiently progressed to furnish results.
2. There is required to be appropriated to finish the scheme of improvement, according to the estimate of November 9, 1866, the sum of $474,109 75.
3. The amount that can be profitably expended during the next fiscal year is $335,000.
4. This work is situated in the fourteenth collection district.
5. The nearest port of entry is Albany, New York.
6. The amount of revenue collected there for the last fiscal year is $19,974.
7. The amount of commerce and navigation to be benefited by this work is about $500,000,000.
8. Abstract of proposals, with names of bidders sent herewith.
9. Abstract of contracts, with names of contractors sent herewith.
10. Abstract of contracts for each class of materials or labor. (Included in No. 9.)

The works to be finished this year are the repairs of the United States dikes, new dike at Cuyler's island, and cutting away the face of Mull's island, with a probable total expenditure of $162,960.

During the next season the long dikes at Castleton, long dike between Lower and Upper Patroon's island, long dike connecting Bogart's island with Westerloo island, the dike from Base island to eastern bank of river, and dredging, will be the probable operations.

For these essential operations there would be required $335,000, and deducting therefrom the balance of the present appropriations, there would be left in round numbers the sum of $152,000, which is asked to be appropriated for the fiscal year ending July 1, 1869.

Respectfully submitted:

JOHN NEWTON,
Lieut. Col. of Engineers, and Bvt. Maj. Gen. U. S. A.

Major General A. A. HUMPHREYS,
Chief of Engineers.

Abstract of proposals for materials and labor on improvement of navigation of Hudson river, New York.

Name.	Laying 15,000 sq. yds. 4th class building stone in a slope wall.	Delivering 6,000 cubic yards 4th class building stone.	Delivering 100,000 feet 8 by 12 inch hemlock timber.	Delivering 4,000 15-foot piles.	Delivering 15,000 lbs. wrought spikes.	Delivering 3,000 lbs. of bolts, with nuts and washers.	Driving 30,000 feet of piles.	Delivering 10,000 cubic yards of stone chips.	Labor on 5,000 running feet of timber work on dike.	Delivering 8,000 cubic yards of rubble-stone, May, 1867.	Sawing off pile heads.	4,000 cub. yards rubble-stone, more or less, October, 1866.	Remarks.
	Per yd.	*P. c. yd.*	*Per M.*	*Per foot.*	*Per lb.*	*Per lb.*	*Per foot.*	*P. c. yd.*	*Per foot.*	*P. c. yd.*	*Each.*	*P. c. yd.*	
Emory R. Seward	$0 50	$1 75	$30 00	$0 12	$0 07½	$0 12	$0 09½	$1 88	$0 40	$1 55		$1 50	
William Fuller		1 75						1 65		1 34			
Lorenzo D. Loomis			27 50				5½						
Morgan Lewis			25 00	18½									
Templeton & Payne							8		5 00				
Thomas Brennan and John Higgins	5												
Simeon Cunliff					5½	8							
McClosky & Grimes	75												
Henry V. B. Barker	48	3 74		25	6½	15		2 48					
R. Nelson Gere	40	2 25	35 00	12	5½	9	10	1 80	65				
Stephen Miles									72				
John D. Hutchinson					6	12							
M. McGinnis					7½	13							
Francis Beaulac					9	12			48				
Thomas Knowlson			30 00										
James Brady	70						5½						
Henry H. Smith			35 00	10½									No quantity attached.
Waltons & Leonard						10							
John H. Taylor					8½	13½							
E. K. Scovill				12									
John W. Costello									14				Misunderstood advertisement.
Patrick Riley							9						
Francis Jacques and John Smith									30				Misunderstood advertisement.
Skinner & Arnold					7½	12							
S. L. Griffith			34 00										
Edmund Raymond				16									
Peter G. Canfield				16									
Asahel Clark	1 60	4 50	30 00	25	13	28	20	3 60	98	4 60			
Samuel D. Trall	95	1 95	35 00	23	9½	15½	20	1 95		1 49	$0 25		
Eph. Owen										1 49			Refused to enter into contract.

I certify that the above is a true abstract.

JOHN NEWTON,
Lieutenant Colonel of Engineers and Brevet Major General U. S. A.

ABSTRACT OF CONTRACTS FOR WORK AND MATERIALS FOR IMPROVING HUDSON RIVER, NEW YORK.

Emory R. Seward.—October 17, 1866, for 4,000 cubic yards of rubble stone, more or less, at $1 50 per cubic yard, to be delivered on the dike.

R. Nelson Gere.—April 25, 1867, for laying 15,000 square yards, more or less, of fourth class building stone in a slope wall on the dikes and islands in the Hudson river, at forty cents per square yard.

Emory R. Seward.—April 26, 1867, for 3,000 cubic yards, more or less, of fourth class building stone, at $1 75 per cubic yard, to be delivered on the dikes and islands.

William Fuller.—April 25, 1867, for 3,000 cubic yards, more or less, of fourth class building stone, at $1 75 per cubic yard, to be delivered on the dikes and islands.

Morgan Lewis.—April 29, 1867, for 100,000 feet, more or less, of hemlock timber, 8 by 12, at $25 per thousand feet, to be delivered at the docks at Albany, New York.

Emory R. Seward.—April 29, 1867, for delivering 4.000 piles, more or less, each 15 feet long, at 12 cents per foot, to be delivered at the dikes.

Simeon Cunliff.—April 23, 1867, for delivering 15,000 pounds of wrought spikes, more or less, at five and a half cents per pound.

Simeon Cunliff.—April 23, 1867, for delivering 3,000 pounds of bolts, more or less, with nuts and washers, at eight cents per pound.

Lorenzo D. Loomis.—April 27, 1867, for driving 30,000 feet of piles, more or less, at the dikes and islands, at five and a half cents per foot.

Emory R. Seward.—May 27, 1867, for preparing and putting in the timber work on 5,000 running feet of dike, more or less, at forty cents per running foot of dike.

William Fuller.—May 4, 1867, for 8,000 cubic yards, more or less, of rubble stone, at $1 34 per cubic yard, delivered on the dikes and islands.

I certify that the foregoing abstract is correct.

JOHN NEWTON,
Lieut. Col. of Engineers, and Brevet Major General, U. S. A.

M 1.

Proceedings of a board of engineers convened in accordance with engineer order, dated Engineer Department, Washington, May 4, 1867.

The board met Tuesday, May 21, 1867, at 11 o'clock a. m., in accordance with the following order:

[Engineer Order.]

ENGINEER DEPARTMENT,
Washington, May 14, 1867.

A board of engineers, consisting of Brevet Brigadier General Hartman Bache, colonel of engineers; Brevet Brigadier General Henry Brewerton, colonel of engineers; Brevet Major General John Newton, lieutenant colonel of engineers; Brevet Brigadier General H. L. Abbot, major of engineers, will assemble at Albany, New York, on Tuesday, May 21, 1867, or as soon thereafter as practicable, for the consideration of the project of improvement of Hudson river, proposed by Brevet Major General Newton, lieutenant colonel of engineers.

The board will report its views, embracing such modifications of the project of improvement, if any, that it may deem essential, and including the proper order of time for the execution of the various portions of the plans.

Brevet Lieutenant Colonel John M. Wilson, captain of engineers, will act as recorder of the board of engineers.

A. A. HUMPHREYS,
Brig. Gen. and Chief of Engineers, Major General of Volunteers.

All the members of the board and the recorder were present.

The order assembling the board having been read, at the request of the board, Brevet Major General John Newton, lieutenant colonel of engineers, read his report on the improvement of the Hudson river, and gave his views upon the subject.

At half past two p. m. the board adjourned, to meet to-morrow morning at nine a. m., on board the steamboat Seneca, to inspect the river.

WEDNESDAY, *May* 22, 1867.

The board met pursuant to adjournment on steamboat Seneca; present, all the members and the recorder.

The board proceeded to inspect the Hudson river between Albany and New Baltimore, thoroughly examining the dikes built by the United States and the State of New York.

At 2.30 p. m. the board adjourned, to meet on steamer Seneca to-morrow at nine a. m., to inspect the Hudson river between Albany and Troy.

At three p. m. the board met informally, and discussed the general subject of river improvement until quarter past five p. m.

THURSDAY, *May* 23, 1867.

The board met pursuant to adjournment at nine a. m., on steamboat Seneca; present, all the members and the recorder. The board proceeded to examine the condition of the Hudson river between Albany and Troy.

The board returned to Albany at two p. m., and at 2.15 p. m. assembled at the engineer office.

The board then entered into a general discussion of the report of Major General Newton; after which, on motion of General H. L. Abbot, the following resolution was unanimously adopted:

Resolved, That the board, after carefully considering the project of Brevet Major General John Newton for the improvement of the Hudson river, and after a personal examination of the river from Troy to New Baltimore, adopt that project, in which are laid down the following essential principles.

1st. A system of longitudinal dikes, designed to confine the current sufficiently to allow the ebb and flow of the tidal current to keep the channel clear. These dikes to be gradually brought nearer together from New Baltimore towards Troy, so as to assist the entrance of the flood current and increase its height; their height to be kept approximately at the level of the tidal high water, so as not to confine the freshets; the exact level, however, being left to be determined by experience as the work progresses.

2d. That the dredge be used so far as necessary to open the channels above described, which the current should not be allowed to do except very gradually, lest accumulations dangerous to navigation be formed below.

3d. Keeping as far as practicable the side reservoirs open to the passage of tidal currents by gaps at their lower extremities, in order to increase the tidal flow.

4th. Dumping all dredged materials in secure places, where it cannot be moved back into the channel by the current.

5th. Constructing the dikes of timber and stone in a manner to secure their permanency at the minimum cost, the details varying with the locality, to be left to the discretion of the local engineer, but to be so designed as to admit of having an increased height given to the dikes if necessary.

6th. To protect when necessary the banks and islands against the abrading action of the currents by revetments.

7th. That limits beyond which no encroachments upon the channel should be made be prescribed, and that any such encroachments be reported by the engineer in charge.

The following resolution was then unanimously adopted:

Resolved, That the plan of improvement proposed by General Newton in his report, and modified by him in a paper herewith laid before the board, (marked A,) be approved, with the remark that the information collected is not yet sufficient to prescribe a plan complete and thoroughly digested in all its details.

General Abbot then presented the following resolution, which was unanimously adopted:

Resolved, That if the amount appropriated for the improvement of the Hudson river was sufficient to complete the entire system above laid down, the work should be begun at New Baltimore and extended regularly upward in all essential features towards Troy.

The existing appropriation being, however, inadequate for such a purpose, the opinion of the board is, that the money should be distributed throughout the entire distance, in such a manner as to meet the most pressing needs of navigation, beginning at the New Baltimore section.

The following resolution was then presented by General Abbot and unanimously adopted:

Whereas the report of General Delafield refers to various accurate surveys of the river, made in 1819, 1831, 1843, and 1852, only two of which surveys are now in the hands of the engineer in charge and available for the use of the board; and whereas the earlier records, both maps and reports, are of the first importance in studying the effects of the works of improvement—

Resolved, that every effort should be made to secure the missing maps, and that they should all be reduced to the same scale for easy reference, and if possible be represented on the same sheet of paper. Also, that a full collection of all reports relating to the river should be made and carefully preserved, and that such as only exist in manuscript should be printed.

There being no further business before the board, it adjourned *sine die* at 6.15 p. m.

HARTMAN BACHE,
Colonel Engineers, Brevet Brigadier General.
HENRY BREWERTON,
Colonel and Brevet Brigadier General, U. S. A.
JOHN NEWTON,
Lieutenant Colonel Engineers, Brevet Major General.
HENRY L. ABBBOT,
Major of Engineers, Brevet Brigadier General.

A.

Modification proposed by Brevet Major General John Newton to the Board of Engineers, at their session of the twenty-third instant.

The works of improvement in the first section, at and near New Baltimore, as laid down in my report of November 9, 1866, and now modified to conform to later information, are recommended as follows:

The existence of a ledge of slate rock across the western channel, at Barren island, renders it impossible without blasting to lead up a much greater quantity of flood tide through this pass, and the filling up of the re-entering below Coeyman's no longer possesses the importance once assigned to it—that of directing the flood current through the western channel.

The channel edge of the filling above Coeyman's should have such a direction as to throw the main body of the ebb through the east channel; and this channel, to compensate for the want of space, as above, in the west channel, to be much enlarged by cutting away the face of Mull's island, for the purpose of admitting a larger volume of flood, and at the same time of the ebb tide.

The widening of the channel between Houghtailing island and New Baltimore to be made the last in the series of improvements in this section.

In the second section, to remove the end of the old State dam, projecting into the channel beyond the contemplated dike.

In the third section, the proposed dike across the mouth of Cooper's Kill, which was designed to counteract the apparent cutting away of the shore of Papscannee island, is probably unnecessary, as further information shows this place to be reinforced against such further abrasion by the uncovering of rock.

The principal works designed for this river, whose general position can now be designed, even in the want of much detailed information appropriate to the case, may be enumerated as follows:

First. The widening of the east channel at Barren island; the amelioration of the re-entering above Coeyman's by a filling of earth, or by a dike.

Second. The long dike between Thorn's dock and Schermerhorn's island, and probably a short one between Campbell's and Low island.

Third. The extension of the United States dike from the head of Bogart's island to the head of Westerloo island, or even to the wharves of Albany.

Fourth. The long dike from upper to lower Patroon's island, and the short dike from Base island to the east shore.

These works should be located in their exact position, and in other particulars, after sufficient information has been obtained from observation.

The want of appropriate data for a finished plan of river improvement has been severely felt, and it is proposed to supply this deficiency by proper observations upon the silt and velocities of the currents, the slopes in the tidal and freshet states of the river, the rises of tides and freshets, by soundings, by borings in the bed of the river, &c.

Such observations, continued for a sufficient period of time to constitute a complete record, would not only be of importance in the execution of the works of improvement proposed, but would serve to suggest works of minor importance which cannot now be certainly specified, and finally enable a comparison to be made in the future of this river and others under discussion.

Although the improvement of a tidal river would suggest, as a general rule, a commencement below, and a gradual working up above, yet it is suggested that an uncertainty or irregularity of future appropriations may render a violation of this rule expedient in the present case, and a devotion of the available funds to the most essential works in the first, second, and fourth sections.

JOHN NEWTON,
Lieutenant Colonel Engineers, Brevet Major General,
Member of the Special Board of Engineers.

A true copy:

JOHN M. WILSON,
Captain Engineers, Brevet Lieut. Col. U. S. Army

APPENDIX N.

UNITED STATES ENGINEER OFFICE,
Newport, R. I., September 11, 1867.

GENERAL: I have the honor to submit the following annual report of progress on the works of river and harbor improvements and surveys in my charge for the year ending September 1, 1867:

IMPROVEMENT OF THAMES RIVER, CONNECTICUT.

The work on Thames river, this season, has consisted in dredging out the channel immediately below the city of Norwich, in the manner recommended by me in my last annual report. Work was commenced on the 5th of June by Mr. E. A. Bill, to whom the contract for dredging was awarded. Up to the first of the present month 14,820 cubic yards of material have been excavated and removed from the channel. The material excavated (which has up to this time been principally sand) has been deposited on flats near the shore, so that there is no danger of its being moved in any way to interfere with the channel. I have now three (3) dredging machines at work on this river, and the work is progressing satisfactorily. I do not propose to attempt to finish the work the present season, for the reason that I desire to observe the effect of the ice and spring freshets on the work done this year. It is possible that the channel may be varied by the above-mentioned causes, and I think it desirable to reserve a portion of the appropriation until the next season, in order to remedy any injury that may occur.

In answer to the requirements of engineer department circular dated June 10, 1867, I have to report as follows:

First. Total amount available for this work at the commencement of the present season	$83,074 50
Amount expended under present plan of operations, up to September 1, 1867	8,653 41
Total amount available September 1, 1867	74,421 09

Second. I consider that the amount appropriated ($84,000) is sufficient to complete the work of excavating the channel to a depth of fourteen feet at high water, and to repair the piers which were constructed in this river by the government for the purpose of contracting the channel.

Third. $74,421 09; the amount available for the work on the 1st of September, 1867.

Fourth. Third (3d) collection district of Connecticut.

Fifth. New London, Connecticut.

Sixth. ———.

Seventh. Fully set forth in my report of November 19, 1866.

Eighth. Enclosure marked A.

Ninth. Enclosure marked B.

IMPROVEMENT OF PROVIDENCE RIVER, RHODE ISLAND, OFF PAWTUXET BAR, AND AT THE CROOK.

The work in this river has consisted in raising and removing from the channel off Pawtuxet bar the sunken wreck of the schooner Mary Stewart, and dredging the channel at the Crook. This wreck was raised in the month of May last by Mr. G. W. Townsend, to whom the contract was awarded. The wreck was moved entirely out of the channel and placed in about seven feet at low water, so as to interfere in no respect with navigation. The cost of raising and removing this wreck was $2,000.

The dredging at the Crook has consisted in deepening and widening the channel at that point Up to the 1st instant the amount of material excavated and removed is 42,219 cubic yards. It is principally mud.

This work will be of great benefit to the harbor of Providence, as it will enable vessels to pass each other with ease, which formerly was impracticable at low water in many cases.

I submit no estimate of funds for this improvement, as the work done this season will, I think, be all that is required in the present condition of the harbor.

No vessels drawing over seven feet can go up to the wharves at low water. Now, all vessels that reach the wharves have an easy access to the harbor.

The city of Providence has appropriated money from time to time for deepening the channel above the Fox Point wharf. This part of the river, on which are located most of the wharves where the principal commercial business of the place is transacted, will require constant dredging to accommodate the increasing trade of the city, and all appropriations made by the general government ought, in my opinion, to be assisted by appropriations from the city or State, and the whole work be placed under one superintendence, with a definite plan fixed upon for the improvement of the harbor.

In answer to circular of June 10, 1867, I report as follows:

First. Total amount of appropriation		$25, 000 00
Amount expended under present plan of operations up to 1st September, 1867:		
Removing sunken wreck, Mary Stewart	$2, 000 00	
Dredging at the Crook	20, 498 94	
Total expenditures		23, 012 94
Amount available for this work, 1st September, 1867		1, 987 06

Second. No appropriation recommended at present.

Third. $1,987 06—the amount available September 1, 1867.

Fourth. Providence district.

Fifth. Providence, Rhode Island.

Sixth. Gold	$164, 097 73
Currency	11, 272 90
Total	175, 370 63

Seventh. The city of Providence and the country about, for which it is the shipping port, contains many large manufactories of almost every description. The cotton mills, iron works, &c, are among the largest in the country. The continued increase of the manufacturing interest, and the present rapid growth of the city, indicate that all additional facilities afforded to the navigation of the harbor will be required to meet the demands of commerce. The number of vessels arriving at Providence during the past fiscal year was 5,414.

Eighth. Enclosures marked C.

Ninth. Enclosures marked D.

IMPROVEMENT OF PAWTUCKET RIVER, RHODE ISLAND.

The work on this improvement has consisted in dredging the channel, so as to obtain a depth of six feet at low water. This is a tidal river, and it is possible that the present work may only have temporary results. The material excavated, so far, is fine sand, and it has been deposited on flats on either side of the channel. I am of opinion that after the channel is deepened so as to give a depth of six feet at low water, up to the wharves of Pawtucket, it will be kept open by the constant passage of vessels which are towed up and down the river.

Total amount excavated up to September 1, 1867, 12,430 cubic yards.

In answer to circular of date June 10, 1867, I report as follows:

1. Total amount of appropriation	$17,000
Amount expended up to September 1, 1867, under present plan of operations	4,409
Total amount available for this work September 1, 1867	12,591

2. I think that the present appropriation is sufficient to afford the depth of water desired, and no further appropriation is asked for at this time.

3. $12,591—the amount available September 1, 1867.

4. Providence district.

5. Providence, R. I.

7. The city of Pawtucket, like Providence, is a large manufacturing depot. The supplies for the factories, in the way of building material, raw material, fuel, &c., and their productions, give employment to a great deal of shipping, and with the present depth of water in the river a large portion of these supplies have to be landed at Providence and carted to Pawtucket. The number of vessels arriving at Pawtucket during the last fiscal year was seven hundred. This number will be much increased by the present plan of improvement of the river, as nearly all vessels engaged in this trade will be able to ascend the river to the city.

8. Enclosures marked G.

9. Enclosures marked H.

IMPROVEMENT OF CONNECTICUT RIVER BETWEEN HARTFORD AND ITS MOUTH.

The survey of this river, with a view to its improvement, was commenced on the 10th of August by Theodore G. Ellis, civil engineer.

It is not possible at this time for me to offer any accurate views as to the work required to be done on this river to improve its navigation. From what I have seen, however, I am of the opinion that it is only a question of dredging the channel, and that the result of the survey will be simply the determining of the amount of material to be removed in order to obtain the desired channel.

The character of the river for twenty miles below the city of Hartford, where the navigation is most difficult, is very similar to that of the Mississippi. The country is alluvial, and the bed of the river is constantly shifting. It was formerly attempted to improve the channel of this river by constructing jetties or piers, but some of these are now under ground, formed by the changes in the river bed, while others are directly in the way of vessels navigating the river. One probable part of the plan of improving the navigation of the Connecticut river will be the removal of a portion of these piers

At the mouth of the river is a bar, on which there is, at low water, a depth of from four to seven feet, as shown by the Coast Survey charts. An examination of this bar, with a view to its improvement, will be made.

The information required by department circular of June 10, 1867, will be furnished with the detailed report of the survey.

REMOVAL OF MIDDLE ROCK, NEW HAVEN HARBOR, CONNECTICUT.

The amount of $5,937 25 of the appropriation for the removal of middle rock, New Haven harbor, having been transferred to me by Captain Mansfield, corps of engineers, brevet lieutenant colonel United States army, it occurs to me that it would be advisable to expend it, if only as a matter of experiment.

The original appropriation for this work, made in 1852, (?) was $6,000, and of this amount $67 75 was expended in attempts to remove the rock by exploding charges of powder on the surface. As far as I can ascertain, these efforts were futile, owing, perhaps, to the want of sufficient depth of water.

Being of opinion that the true way of removing this rock was by drilling holes and blasting in the ordinary way, I requested and obtained authority from you to expend the balance of the appropriation. Mr. G. W. Townsend made me an offer to remove four feet from the top of the rock for the sum of $5,000, or he would work by the day and do what he could with the money available. The department having preferred that the work should be done by days-work, I made an agreement with Mr. Townsend, by which he was to furnish one sloop and crew, diving apparatus, divers, scow, drilling machines, galvanic battery, powder, and all material for blasting rock under water, for the sum of eighty dollars per day.

He commenced work on the 13th of July and is yet at work. On the 23d of August I visited the rock and found that there was on the rock fourteen feet at low water, an increase in the depth of five feet. Mr. Townsend is of the opinion, that he can take off another foot with the fund available. The work has progressed much better than I anticipated, even under the most favorable circumstances, and this season has been unusually unfavorable.

I estimate the amount required to cut down this rock so as to give the depth of water originally proposed, viz: seventeen feet at low water, at $30,000.

In answer to circular of June 10, 1867, I report as follows:

1. Amount available for the work at the commencement of the present season	$5,937 25
Amount expended to September 1, 1867	3,500 00
Amount available for the work September 1, 1867	2,437 25

2. $30,000.
3. $2,437 25—the amount available September 1, 1867.
4. New Haven district.
5. New Haven.

BLOCK ISLAND.

The survey of this island, with a view to the construction of a breakwater to form an artificial harbor, was commenced on the 19th of July last, and finished on the 5th instant. The survey was made by Colonel G. W. Dresser, formerly of the fourth artillery, and he is now engaged in making the necessary drawings to illustrate the results of his examination.

I enclose herewith his preliminary report, marked I, fully indorsing the views expressed by him. There can be no question but that a harbor of refuge at Block island would be of great benefit to the major part of the commercial interests of our Atlantic coast, and in time of war it would be a most convenient rendezvous for naval vessels belonging to a squadron stationed on this coast.

Detailed plans and estimates of a breakwater at Block island will be forwarded as soon as practicable.

The information required in circular of June 10, 1867, will be forwarded with detailed report.

WESTPORT HARBOR, CONNECTICUT.

No work has been done on this improvement up to the present time, except a survey to ascertain as near as possible the cost of making the necessary improvements.

The amount appropriated for this work ($2,500) was evidently inadequate to perform the work required, which consisted in, first, the repairs of the breakwater on Cedar Point. This will require 120 cubic yards of stone. Second. Repairs of the walls of the canal leading from the harbor to the sound, and excavating the canal. This will require 619 cubic yards of stone, and 7,290 yards of excavation to obtain a depth, at low-water, of two feet. To obtain a depth of four feet, at low water, will require 15,054 cubic yards of excavation. Third. Removal of obstructions in the channel of the river.

I make the following estimate of the cost of the work:

739 cubic yards of stone laid in walls	$7, 390
15,054 cubic yards of dredging and excavating, at 25 cents per yard	3, 763
Removal of obstructions	1, 000
	12, 153

The only work that can now be executed to advantage is the repair of the breakwater on Cedar Point and the walls of the canal. This work will be executed this fall as far as the appropriation will permit. The amount required to complete the work of improving this harbor, in addition to the amount already appropriated, is $10, 000

In answer to circular of June 10, 1867, I report as follows:

1. ———.
2. $10, 000.
3. $10, 000.
4. Fairfield, Connecticut, district.
5. Nearest port of entry, Bridgeport, Connecticut.

I am, general, very respectfully, your obedient servant,

D. C. HOUSTON,
Major of Engineers, Brevet Colonel U. S. A.

Major General A. A. HUMPHREYS,
Chief of Engineers, U. S. A., Washington, D. C.

A.—*Abstract of proposals for improvement of Thames river, Connecticut, during the year ending August* 31, 1867.

To dredge out the channel of Thames river immediately below the city of Norwich, Connecticut, to obtain a channel of fourteen feet at high water:

James Y. Smith, eighty-five (85) cents per cubic yard.
E. A. Bill, forty-five (45) cents per cubic yard.
A. J. Hackley, sixty thousand ($60,000) dollars to complete the work.

D. C. HOUSTON,
Major of Engineers, Brevet Colonel U. S. A.

B.—*Abstract of contracts for improvement of Thames river, State of Connecticut.*

To dredge out the channel of the Thames river, Connecticut, immediately below the city of Norwich:

E. A. Bill, forty-five (45) cents per cubic yard.

D. C. HOUSTON,
Major of Engineers, Brevet Colonel U. S. A.

C.—*Abstract of proposals for improvement of Providence river, off Pawtuxet bar and at the Crook, during the year ending August* 31, 1867.

For removing the sunken wreck Mary Stewart from the channel of Providence river, off Pawtuxet bar:

Eben W. Eaton, twenty-four hundred dollars, ($2,400.)
Jacob Palmer, twenty-two hundred dollars, ($2,200.)
George W. Townsend, two thousand dollars, ($2,000.)

For dredging out the channel of the Providence river at the Crook:

James Y. Smith, one and seven-eighths (1⅞) cent per cubic foot.
Sampson Wardell, one and one-quarter (1¼) of a cent per cubic foot.
Thomas J. Hill, one and one-half (1½) cent per cubic foot.

D. C. HOUSTON,
Major of Engineers, Brevet Colonel U. S. A.

D.—*Abstract of contracts for improvement of Providence river, off Pawtuxet bar and at the Crook, during the year ending August* 31, 1867.

Removal of sunken wreck Mary Stewart from the channel of Providence river, off Pawtuxet bar:

George W. Townsend, two thousand dollars ($2,000.)

Dredging the channel of the Providence river at the Crook:

Thomas J. Hill, one and one-quarter (1¼) cent per cubic foot.

D. C. HOUSTON,
Major of Engineers, Brevet Colonel U. S. A.

G.—*Abstract of proposals for improvement of Pawtucket river, Rhode Island, during the year ending August* 31, 1867.

For dredging out the channel of the Pawtucket river, Rhode Island, between the city of Pawtucket and the Red bridge:

S. S. Wardell, five (5) cents per cubic foot.
Thomas J. Hill, four and one-quarter (4¼) cents per cubic foot.
C. A. Nichols, three (3) cents per cubic foot.
(All the above bids were rejected.)
Templeton and Payne, thirty-five (35) cents per cubic yard.
A. Sickles, fifty-four (54) cents per cubic yard.
Thomas J. Strong, forty-five (45) cents per cubic yard.
S. S. Wardell, eighty-one (81) cents per cubic yard.
E. R. Seward, seventy-five (75) cents per cubic yard.
Charles A. Nichols, seventy-four (74) cents per cubic yard.
Thomas J. Hill, eighty-one (81) cents per cubic yard.

D. C. HOUSTON,
Major of Engineers, Brevet Colonel U. S. A.

H.—*Abstract of contracts for improvement of Pawtucket river during the year ending August* 31, 1867.

To dredge out channel of the Pawtucket river, State of Rhode Island, between the city of Pawtucket and the Red bridge, to obtain a channel of six (6) feet at low water and seventy-five (75) feet wide:

Templeton and Payne, thirty-five (35) cents per cubic yard.

D. C. HOUSTON,
Major of Engineers, Brevet Colonel U. S. A.

I.—*Report of Colonel G. W. Dresser.*

NEWPORT, RHODE ISLAND,
September 10, 1867.

COLONEL: I have the honor to submit the following as a preliminary report of the survey made by me "with a view to the location of a breakwater which shall form an artificial harbor," at Block island.

Pursuant to your instructions contained in letter to me, dated Engineer Office, Newport, Rhode Island, July 11, 1867, I proceeded to Block island, arriving there July 19, 1867.

I was engaged until July 24 in making an examination of the entire shore of the island, as well as most of the interior of it. There is not a ledge of rock to be found on the island anywhere, and no appearance of rock on the shores excepting boulders, which have been unearthed by the action of the sea against the land. These vary in size, but are mostly small, and are quite uniformly distributed around the shóre, from the eastern, around the southern, to the western point of the southern or larger part of the island. There are some deposited also on the shore at Clay Head, on the northeastern point of the island. None of these are available in the construction of a work, for two reasons, viz: First, they could not be removed from the positions they now occupy to the point required so economically as stone could be procured from quarries abounding on the shores of the neighboring mainland even if the quantity available on the island shores was sufficient. Secondly, they should be left where they are to protect, as far as they will, the shores of the island from wearing away by the action of the sea, which, though very slight, should not be disregarded.

The surface of the island is rolling land, with a fertile soil, and the whole is underlaid with clay, which, in most cases, is dry and tough. On the south end of the island the land is high, and these clay cliffs stand almost vertically at a height of from 75 to 125 feet above the ocean, at the foot of which sand and gravel beaches slope off gradually and uniformly into the sea.

The two points presenting themselves as fit ones for a work to form an artificial harbor were, first, a point on the west beach near the Salt pond, where it has been proposed to make an opening through the beach to form a ship channel into the pond, which, in that case, would form a harbor. Second, a point near Sands's landing, at the southeast point of the bay, on the east side of the island, where, by constructing a breakwater of stone, running in a northerly direction, a perfect harbor, with smooth bottom and excellent holding-ground for anchorage, could be obtained.

At the first point careful surveys were made, and in my final report I will submit profiles of the cutting, estimates of the amount and cost of excavation required, together with a map of the pond, with the soundings thereon. The area of this pond is about eight hundred acres, but at least one-third of it is shoal water, not exceeding five or six feet deep. The deepest water found was sixty feet, with several feet of mud at the bottom, but the average depth of that portion of the pond which could be available for vessels would not exceed twenty-five or thirty feet. The bottom is very uneven. The pond is separated from the sea on the east, and the sound on the west, only by sandy beaches, which have probably been thrown up by the action of the sea, thus uniting in one what probably was once two distinct islands. I am told that in heavy storms and high tides in the winter, the water rushes over the east beach into the pond, frequently cutting off communication along that shore between the north and south ends of the island.

This pond *freezes up in the winter*, ice sometimes forming from eighteen inches to two feet thick.

In making a cut through the west beach into the pond, it would be necessary to excavate a channel, nearly at right angles to the line of the beach, in the sand for a considerable distance into the sound. This would fill up at once to low-water mark, unless a work was constructed to protect it and keep the sand out; and to whatever extent a pier was built for this purpose, the sand would eventually work around the head of it, and together with the sand blown from the shore, would form a bar which would constantly be shifting its position, as the rise and fall of the tide would form a strong current to and from the pond through the opening.

The present level of the pond is about three feet above low-water mark. The average rise and fall of the tide is about three feet and a quarter. The ordinary spring tides are about four and a half feet. An opening at this point would be subject to a heavy sea surf directly from the ocean, along the westerly shore of the island, in a southwest storm, and during a southeast or easterly storm, a vessel would have a head wind to beat through a channel not over six hundred and fifty feet wide into the harbor.

From the careful consideration of this subject, after examining the point myself, and getting all the information possible from the inhabitants, I conclude that any expenditure at this point would fail to secure a harbor *available at all times*, and that a large and constant annual outlay would be required to keep open any channel cut there.

With reference to the second point—a work on the eastern part of the island which would form a protection to vessels anchored in the bay—I have made a survey of the shore of the bay and procured the necessary information and data to make a map, showing the depth of water, character of the bottom, &c., of the entire bay.

The point at which I would propose to locate the starting point of a breakwater is on the shore about five hundred feet east of the present landing. The bottom is smooth and hard, free from rocks, and the water deepens gradually to six or seven fathoms at a distance of half a mile from the shore, and attains a depth of ten fathoms at about one mile from shore, in the direction of Clay Head.

The only reasonable limit to the number of vessels that could be safely sheltered here is the extent to which the work is carried. There are no obstacles to be overcome in the construction of a work here, other than those which ordinarily arise in works of this kind upon a good solid foundation, where the stone can be placed by vessels anchoring at the line of the work and throwing stone overboard to make the foundation for the sea-wall on top of them. The protection to vessels would be complete from all winds.

The demands of our commerce, and the necessities of our navy, in defending Long Island sound in case of a foreign war, would be amply met by a work of reasonable extent and expense at this point.

In my final report, which I am now preparing, I will submit plans, &c., of the work, with the maps, estimates, &c., in full detail.

Every courtesy and facility was most cordially extended to me by the people of the island during my stay there. I kept a record of the tide taken once an hour during the day, and also of the thermometer and the wind, taken three times a day during the time I was on the island, which I shall submit in tabular form with my final report.

I am, colonel, very respectfully, your obedient servant,

GEORGE W. DRESSER, *C. E.*

Colonel D. C. HOUSTON,
United States Engineers, Newport, R. I.

APPENDIX O.

New Bedford, Mass., *June* 7, 1866.

General: I have the honor to report that, in obedience to the instructions of the department dated the 19th ultimo, I visited Duxbury and the neighboring beach, and conferred with Mr. G. B. Weston. I beg to submit the following remarks on the object of the instructions of the department:

Duxbury bay and harbor are separated from the Atlantic ocean by a long, narrow beach extending for five or six miles from the mainland, in a southeasterly direction, to a headland called the Gurnet, thence westerly a mile or more to another high point known as Saquish head. The beach, throughout most of its length, is about seventy-five yards in width, and rises to a general level of about ten feet above ordinary high tides. In many places depressions of several feet occur, through which it is said the sea is liable to flow on the occasion of a spring tide accompanied by the prevalent easterly wind.

On the Gurnet there is a field-work, and on Saquish head another, both built during the war, which constitute the defences of Plymouth as well as Duxbury harbor. Mr. Weston represents that these points are at times, for a couple of months in the winter, inaccessible by water, the beach being the only communication. In this statement, to my mind, lies the main argument that can be urged with any force in favor of the proposed repair. As the harbor appeared to me, and from the best information I could gain, it is of little value, on account of the flats which occupy almost all its extent. I have not seen a chart of the harbor, and have been compelled to form my opinion from a cursory examination, but I would respectfully refer to the Coast Survey report for the depth of water, &c. There is no commerce, and even the fishing smacks have sought other ports.

About thirty years ago an appropriation of $5,000 was expended upon this beach, under the direction of Colonel Totten, in planting two rows of stakes, three or four feet apart, and filling the enclosed space with brush and seaweed, which served to collect and retain the sand, upon which beach grass was set out. The grass gave cohesion to the mass, and held it in place long after the woodwork had disappeared This simple measure seems to have served a good purpose, and if it be decided to repair the beach now, I would recommend this as the most economical means.

The aggregate in length of the breaches or depressions is supposed to be about two miles, and will require about $4,000. The estimate as to the length is that of Mr. Weston rather than my own, as the stormy weather prevented me from ascertaining the fact for myself. I was the less inclined to spend much time in measurements, as the whole project struck me as one I could not recommend.

I am, very respectfully, your obedient servant,

G. H. MENDELL,
Major Engineers, Brevet Colonel U. S. A.

Brevet Maj. Gen. Richard Delafield,
Chief Engineer U. S. A., Washington, D. C.

New Bedford, Mass., *October* 14, 1867.

General: In accordance with instructions of the 7th instant, I have visited Duxbury beach, Massachusetts, and would respectfully submit the following report:

The harbor of Duxbury at time of high water is very large, but so shallow that when the tide is out it consists only of a few narrow winding channels and a vast extent of marshy flats. It seems to be used only as a resort for a few fishing vessels or occasional coasters with articles for local consumption.

This harbor is separated from the outer sea by a narrow beach rising ten to twelve feet above the level of high water, and about six miles long. A further description of this beach is given in the report of Colonel Mendell on this subject, to which I would respectfully refer. Several depressions occur in the crest of this beach, of an aggregate length of about 1,500 feet. These, save 500 feet, require but slight repairs to prevent the water from breaking over. The remaining parts would require a substantial work.

From observing the cost of repairs on the adjacent and similar beach at Plymouth, I make the following estimate, viz:

500 feet, at $4 per foot	$2,000
1,000 feet, at $2 per foot	2,000
Total for completing the repairs	4,000

In case it be decided to make these repairs, I would recommend a similar means to that used many years ago, viz: two rows of stakes, with the space between filed with seaweed. Parts of this old work still remain, and in some places still serve a good purpose in protecting the sand from translation by the wind. The more exposed positions would require a substantial work, for which a triangular frame similar to that used at Plymouth would be well adapted.

I fully concur with Colonel Mendell in feeling that neither the value of the harbor nor the present danger of injury to the beach are sufficient to justify a recommendation in its favor.

Very respectfully, your obedient servant,

JARED A. SMITH,
Brevet Major U. S. A., Captain of Engineers.

Brevet Maj. Gen. A. A. HUMPHREYS,
Chief of Engineers, U. S. A., Washington, D. C.

APPENDIX P.

BOSTON, MASS., *September* 5, 1867.

GENERAL: In accordance with your circular of June 10, No. 11, I have the honor to make the following report in relation to the works carried on during the past year for the "preservation of Provincetown harbor, Massachusetts."

As more fully stated in my report of last year, this work at the commencement of the previous year was under the charge of the late Colonel J. D. Graham, corps of engineers, who, in November, 1866, had made a report and estimate for the works at that harbor.

In March, 1867, a further examination, report, and estimate was ordered by the engineer department to be made by Major Blunt and myself, which was completed in April and at once approved by the department, and the estimate ($8,000) was called for and received in July, 1866.

This report of April, 1866, proposed that some repairs should be made to the old bulkhead at Long Point, next the light-house, and an additional work of about the same size and character with that should be placed in front of the site of the farther or upper battery, about from twelve hundred to sixteen hundred feet from the light-house. Also, a similar work on Beach Point, east of Provincetown, from one-fourth to one-half mile southeast of the inlet or bridge. Also, (in which it agreed with Colonel Graham's report,) the planting of a brush and beach grass protection at three specified points on the seaward side of the sand ridge, at the east of East Harbor Meadow, to secure those positions from any possible inroads of the ocean upon the main harbor through east harbor and its lowlands.

The work was just commenced in June, 1866, at Beach Point, and was vigorously pushed on all the positions above referred to in the next month, July, the first of the fiscal year, now reported upon, and by the month of September about ten acres of beach grass, with interlacing fences of brush, &c., had been planted at the points on the sand ridge referred to east of East Harbor Meadows, giving a satisfactory protection, and all that thus far appears to be needed to this position.

At Long Point, in front of the upper battery, a bulkhead about seven hundred feet long was constructed, with three jettees, each projecting about sixty to seventy feet, and four brace jettees, of about twenty-eight to thirty-two feet, placed intermediately with the longer jettees. A large space in the rear of central position of this bulkhead, where the sea had made in towards the battery, was filled in with sand, and for some thirty to forty feet in width, in rear as well as at the extremities in front, it was planted with beach grass, while belts of beach grass were planted in different directions in the peninsula, opposite and near this work, so as to secure the drifting sand and prevent currents of water, &c. This bulkhead, of the character of those previously used with success in that locality, consists simply of a two-inch plank fence from five to say seven feet high, with batten of one-fourth to one-fifth, with posts four feet apart and six to eight inches across, set three to five feet in the sand and secured to the rear by one or two braces ten to twenty feet long dove-tailed to the posts and held at the lower or inner end by pickets or short cross-ties, the earth being filled in rear to near the top of the fence and planted with beach grass roots eighteen to twenty-four inches apart. The front of the bulkheld is protected by jettees, which also secure and raise the sand on the outside. The best form as thus far found, and as used in the bulkhead at this battery, are placed at intervals of eighty to one hundred feet, projecting outward from fifty to sixty feet, two to three feet high at the outer end, and four to five feet high, or two or three feet lower than the top at the bulkhead, built of posts at the bulkhead, as far in the ground as out, and planked on both sides and at top; and these, with intermediate or brace jettees, (every twenty-five to forty feet,) to be of an oblique bracing timber twenty-five to thirty feet long, running from near the top of the bulkhead to the surface outside and supported by posts planked on both sides like the other jettees, constitute the best protection of a simple and inexpensive character as thus far used for these localities; and the bulkhead erected in front of this upper battery has thus far stood perfectly well, answering all the purposes expected of it in securing the beach in rear and in causing a considerable accumulation of sand in front.

I would report in relation to the bulkhead next to the Long Point light-house, erected by Colonel Blunt in 1853, to which some repairs were given by myself in 1857, and which is of the same general character with that above described, for the last twelve or fourteen years had answered most effectively the objects intended, to preserve and widen the narrow strip of sand beach, with its planted beach grass, which connects the site of the light-house with the broader parts of peninsula of Long Point. Some slight repairs and modifications, all that were deemed necessary, were given to this position last season, and it was left in its usual good condition at the approach of winter. I regret to state, however, that during the month of January last a violent storm raged there which very singularly did not injure the new work, first described as erected last year and almost similarly situated, and within a half mile of that next to the light-house at Long Point, yet it almost completely destroyed this latter work, carrying away large portions of the bulkhead and the jettees for the most part, and sweeping out large portions of the sand that had accumulated between the jetties and been placed in rear of the bulkhead, and it reduced the width of the isthmus there in some parts to some thirty feet only, which has fortunately still remained unbroken, being protected mainly by the beach grass still in position there. No repairs, however, have as yet been made there during this present year, as a board of engineer officers had been asked for to consider the best protection advisable for the future for this and other positions where the bulkhead had been injured in this harbor.

This board of officers, consisting of Generals Bache, Foster, and myself, convened there as ordered about the close of June, and, substantially indorsing the former action of the engineer board and officers in relation to the works, it recommended the re-erection of a bulkhead essentially similar to that just destroyed, and the continuance or prolongation in front of it of a breakwater or riprap of large rough stone, which at just below the level of half tide has remained very permanently in position and appeared to give very effective protection to that pier for the past twenty years or more.

In accordance with the recommendation of this board and the law of Congress of 1866, making the special appropriation for this harbor, proposals were called for and a contract has been made within the past month for the construction of this work and the extension of this breakwater, for which the preparations are now being made so as to complete them during the present season and before the close of November.

The position, however, *not* where in my opinion the main injury is likely to occur, which is at Long Point, but to which the principal complaints of some of the citizens have been directed, and where the main difficulties have as yet occurred, are at Beach Point and the inlet of East Harbor. The principal portion of the sum of $43,000, estimated for by Colonel Graham, or over $38,000, was proposed to close this inlet by a loaded crib-work, this opening being nearly 900 feet in width at the end of Beach Point.

This peninsula of Beach Point is of great value to the people of the vicinity as a means of communication with the main portion of Cape Cod, and the closure of this inlet would undoubtedly be very desirable for this purpose, either for the present common road or for any projected railway. But the necessity for this closing of this inlet as a means of protecting or preserving the harbor was not apparent to the first board of engineers, as shown in our report of April 28, 1866, nor does it appear at present expedient, as stated in the report of the second board ordered June 6, 1867, especially in view of the fact that this inlet, by the testimony given to us, had narrowed by some 3,000 feet within the memory of old residents who accompanied us there, and latterly at an accelerated rate, and the water way at the opening in April, 1866, did not show a depth generally of more than twenty-five to thirty inches at low water for hundreds of feet on either side of the bridge; yet as there was at that time a deep hole within or above the bridge, and the peninsula about one-third of a mile southeast was worn by the sea to a narrow ridge of some twenty to thirty feet, the possibility of this part being broken through and the present *point* being left as an island by which a current might be established through that deep hole to the bridge, that possibly could thus force the sand out to the harbor, induced Major Blunt and myself to recommend a bulkhead protection at this point of the Beach Point peninsula, one-third of a mile from the bridge.

This recommendation was approved and carried out, and during the last half of 1866 a bulkhead was constructed at this point much stronger than either of those at Long Point, though generally of the same character. It was about 1,250 feet long, curved or indented inward, or concave to the sea, some 300 feet from a right line—about half the curvature of the shore—that this roadway ridge at the indentation might be widened and strengthened. This bulkhead had four jettees, each projecting from 45 to 60 feet, and fourteen *brace* jettees of 25 to 35 feet, and the earth in rear was filled up to nearly its full height with sand and planted with beach grass, its object being to secure this narrow ridge and to increase its width by retaining the sand drifting towards it from the south. I regret to say, however, that when this work was about half completed, and again when it was just on the point of being finished very satisfactorily, a succession of gales of unusual violence from the southwest occurred there, and at each time they injured the then unfinished work to a very great extent, and the labor was continued at intervals actually till the close of December in the attempt to secure as much as possible of the work—to preserve the ridge during the winter months—at which time, as by the report of my assistant, Lieutenant Lockwood, about two-thirds of the work executed remained in tolerable condition to afford protection to this ridge, and without much greater injury it so remained until the visit of the last board of engineers in June last.

My opinion then expressed to this board is still my conviction, that I could not rely upon it that any similar structure would be strong enough to insure a protection to the peninsula in that position, and that how valuable soever this might be as a roadway to the inhabitants, I did not think that the expensive works that alone could be relied upon to resist the waves there were either called for or justified by any possible danger to the harbor from injuries to the shore line, and though the report of this board, which was approved, favored further construction of this less expensive character here, I was quite gratified to be able to report, as on August 5, that at my visit about the first of that month I found very great and advantageous changes, strongly sustaining the position I had held. I found within *the month* a very great change towards the closing of the inlet, the "deep hole" of last year filled up, and a bar across it at low water, and for acres above and to within about 100 yards of the bridge, where there had been two to three feet water at low water in April, 1866, there was a bank of sand two feet out of water, leaving a width of water-way less than 100 feet, where it had been 800 to 1,000 in April, 1866, and at the bulkhead a still more extraordinary change for the better was found; for though the sand had previously made for some 100 to 200 feet along its southeast part, it had within the month or two previous extended along nearly the whole of the about 800 feet remaining, filling up in rear to high-tide lines and filling up to the level of all the jettees, even burying some out of sight, and in fact accomplishing most completely the very purpose and every purpose which was expected from its condition originally.

Now, though of course I cannot feel any positive surety of the continuance of this recent increment upon this treacherous sandy shore, yet as so much is recently accomplished of what had been most to be desired from the filling of that deep hole, and from the new bank at the inlet, I now can have no fear of any island or island eddies being formed from the inlet to injure the harbor, and I can anticipate no damage more than perhaps a temporary injury to the roadway, and I must feel assured that no expensive structures of timber or stone can be required here, while with the belief that the dangers of last year are being rapidly repaired by natural causes, I have the hope even that this slight bulkhead will not need to be replaced, though I have provided for such work in the contract just completed for the Long Point bulkhead, should I find it necessary and give notice within one month from the date of that contract, which I trust will meet the approval of the department.

The funds on hand and in the treasury, it is expected, will be ample for all expected expenditures according to the report of the board of engineers for the present year, and for the ensuing fiscal year ending June 30, 1869.

In recapitulation I would state that the works for the protection of Provincetown harbor during the fiscal year are as follows: a new plank fence bulkhead about 700 feet long, with the necessary jettees, has been constructed for the protection of the shore and battery about one-third of a mile southwest from Long Point light, the extreme point of the Cape, to which this work has given full security thus far, and during the autumn of 1866 the old bulkhead adjacent to the light was repaired, though it was, to a great extent, destroyed by the storms of the past winter. For the restoration of the bulkhead, however, to the extent of 600 to 700 feet, and for a rough stone breakwater, a contrrct has been made, by which it is expected to be completed during the present autumn.

At the outer sea beach, east of East harbor, the necessary brush "catch-sands" and beach grass have been planted to give all the present security desirable there, the spaces thus planted comprising about ten acres.

At Beach Point peninsula, at one-third mile from the bridge, a plank-fence bulkhead was constructed, about 1,250 feet long, with the necessary jettees, in the autumn of 1866, and this, though seriously injured by the autumnal gales and by the storms of winter, has yet for the most part remained in position; and though at the first it gave some protection and an increase to the sand-bank in front of its eastern end for perhaps 100 to 150 feet only, I now am able to report that, just after the close of the fiscal year, the two-third portion of this bulkhead remaining was giving most efficient protection—all that had ever been hoped from it—to the shore of this peninsula, having carried large deposits of sand, in front as well as in its rear, of the work, while the contract made for the Long Point bulkhead provides for the extension or repairs of this, if it shall prove necessary, of which necessity much doubt still exists. And the inlet of East harbor, at the extremity of Beach Point, the closure of which is desirable, I am able to report has during the past year, by natural causes alone, filled up to a very great extent, so as to give the expectation that but little, if any, expenditure will be required for closing the same by artificial means.

Although no expenditures have been made under either of the laws referred to in Circular No. 12, I append the information required as to the items Nos. 4, 5, 6, 7 of this circular, as reported upon in the accompanying paper A, from information derived principally from the collector's office in this city. And as to proposals and contracts, I would remark that an advertisement was issued in October, 1866, inviting offers for contract, to which no response or bid was offered within the time required, and no contract was made during the fiscal year ending June 30, 1867.

The funds available, expended, and on hand, are as follows:

Furnished for use of this work from the appropriation for harbors on the Atlantic coast from July to December, 1866	$15,000 00
From appropriation for "preservation of Provincetown harbor," made in 1866	3,000 00
	18,000 00
Expended during the fiscal year	11,292 05
	6,707 95
On hand July 1, 1867, of funds from appropriation for harbors on the Atlantic coast	$3,707 95
On hand July 1, 1867, of funds from appropriation for preservation of Provincetown harbor	3,000 00
	6,707 95
In treasury of the United States undrawn, from the appropriation for preservation of Provincetown harbor	40,068 44
Total available	46,776 39

And no further appropriation is deemed requisite at present.

I am, sir, very respectfully, your obedient servant,

H. W. BENHAM,
Colonel of Engineers, Brevet Major General.

Major General A. A. HUMPHREYS,
Chief of Engineers.

BOSTON, MASSACHUSETTS, *April* 12, 1867.

GENERAL: I have the honor to forward herewith, as useful for the files of the department, a sketch of Cape Cod harbor, with enlarged plots of Long Point and Beach Point, with the plans of the bulkheads at these positions. The bulkhead nearest the light-house at Long Point was constructed by Colonel Blunt some fifteen years ago, and stood very well up to this past winter, having received some repairs, under my direction, last summer. During this past season, however, serious damage is reported to it; and when the good working season shall have fairly come I propose to make these repairs, applying for the purpose what, I think, will be useful in that position—the continuous longitudinal box, filled with sand, in *addition* to, and in rear of, the bulkhead.

The bulkhead farthest from the light-house at Long Point, in front of the five-gun battery, was constructed last summer, and is reported to be in essentially good condition and uninjured.

As to the bulkhead at Beach Point, in front of East harbor, the plan of which as left at the close of work in December is also shown, I would state that, as previously reported, many injuries occurred to it repeatedly in the course of construction, so that, after several repairs, it was left, as shown, somewhat irregular in plan upon the 31st of December, 1866. By the report of the watchman in charge, the bulkhead as left at that time has not changed essentially for the worse up to this date. although, from his report, I have some reason to fear it has suffered as much from the depredations of the people near as from the sea, "three boats, loaded" with the, perhaps, broken materials, being reported as "seen at one time leaving this work."

Upon the 13th of February I suggested to the department that, in the proposed visit of the board of engineers to select a site to be surveyed for the principal military work at Provincetown, we should be authorized to examine this position, (if not that at *Long Point* also, with the same object,) that the views of these additional officers might be had as to the expediency of any works of *much greater expense* for this position. I refer to this again, as a further reflection makes me doubt—in which doubt Colonel Blunt states that he coincides with me—whether any great danger to the main harbor can possibly be anticipated from even the breaking through of this neck or tongue of land into East harbor that would justify any great or extraordinary expenditure for its further protection.

Undoubtedly the greatest value of this tongue of land now is from its giving the best—I might say the only *tolerable*—means of communication between Provincetown and the main part of the peninsula of Cape Cod, and for this purpose it has been sedulously cared for and its injuries repaired from time to time by the inhabitants of the adjacent towns.

The injuries that were to be feared, and on account of which Colonel Blunt and myself felt justified in recommending some expenditure there in our report of April 28, 1866, were mainly that if this tongue of land were broken through and a new cut made into East harbor, an island being left to the east of the bridge, it was possible that eddying currents *might* carry sand to a considerable extent out into the main harbor, to its injury. This, it is true, we considered perhaps rather as a *possible* than a *probable* danger, and, as such, we felt the small expenditure of $2,000 to $3,000 might be justified, although, from the peculiarly bad season, the cost of the work there already done has been about double this amount, and the work is very defective and the protection has been by no means perfect. And in consideration of further work there, if nothing will stand permanently except an expensive structure of large piles or heavy timber, or stone and timber work, at an expense at least of from $15,000 to $30,000, as I think it must be, I would say that my present opinion is that this contingent or probable danger to the harbor is not such as to justify such an expenditure in this position.

To enable me to use most efficiently and economically the appropriation that was last made for this work, I would respectfully recommend that authority should be given (as I understand the law permits) that these funds should be expended and used, as the other funds have been heretofore, for the preservation of this harbor. I may add, in explanation of this request, that after having, to the best of my ability, last autumn, prepared the advertisement for work there, to meet the requirements of the law and also to protect the public interest, I did not *get a single bid* according to the terms of my advertisement.

Very respectfully, your most obedient servant,

H. W. BENHAM,
Brevet Major General.

Major General A. A. HUMPHREYS,
Chief of Engineers.

BOSTON, MASSACHUSETTS, *July* 4, 1867.

GENERAL: I have the honor to enclose herewith (which had been left in my office for copying) the report of the board of engineers for Provincetown harbor. My further reflection since the meeting of the board makes me feel it proper to say that I had earnestly wished that the other officers had been willing to designate more distinctly the kind of structures they deem most expedient at Beach Point and at Long Point, though it is true they have generally approved those already placed there. Yet *I have not been satisfied* with these structures myself, and yet could not think of others that would probably answer and withstand the force of the sea, except such as would involve a very largely increased outlay, and for such greater outlays, especially at Beach Point, I can see no justification for any danger we could anticipate to the harbor. For this Beach Point peninsula, in fact, as I believe I previously reported to you, the great value is as a roadway, for which it is of the highest importance to the people of the vicinity. But I think all probable injury to it by the sea would scarcely be likely to injure the harbor, and I believe this is the opinion of the other members, though they did not think it necessary to express it in a formal report; and entertaining this opinion myself, if this report is approved, as I cannot now see a justification of expensive structures at Beach Point, I have great doubts, I must say, about following essentially the plans adopted last year, in the fear that, with any of the slighter modifications recommended, a succession of similar southwest storms might again destroy them.

In other words, this slighter work will, of course, be as well constructed as possible, if ordered; but I cannot have the confidence in its strength and endurance that I would wish.

I am, sir, very respectfully, your obedient servant,

H. W. BENHAM,
Brevet Major General.

Major General A. A. HUMPHREYS,
Chief of Engineers.

The board of engineers—composed of Brevet Major General Hartman Bache, colonel of engineers; Brevet Major General H. W. Benham, colonel of engineers; Brevet Major General J. G. Foster, lieutenant colonel of engineers—constituted by Engineer Order 43, dated June 6, 1867, "for the consideration of the plans for the preservation of the harbor" at Provincetown, Massachusetts, embracing the nature and extent of the works to be constructed at Beach Point and Long Point," assembled, at the call of the president, on Wednesday, June 26, 1867, at Boston, and proceeded thence the same day to Provincetown to make examinations of several localities in regard to which the attention of the board had been called. These examinations, at once entered upon, were completed on the 27th, and the board returned on the 28th to Boston, and held a meeting in furtherance of the object of its appointment.

Besides information in the knowledge of Brevet Major General Benham, the engineer of the harbor, communicated verbally by him, the following described papers were laid before the board and read:

1. Report of Colonel J. D. Graham, corps of engineers, dated Boston, Massachusetts, November 28, 1865, with tracings numbered 1 and 2.

2. Report of board of commissioners of the Commonwealth of Massachusetts, dated Boston, Massachusetts, November 16, 1865, H. Doc. No. 395, May 8, 1866, marked A.

3 Report of board of engineers, consisting of Brevet Brigadier General H. W. Benham and Major C. E. Blunt, corps of engineers, to the Chief of Engineers, upon the best plan "for protecting Provincetown harbor in the most permanent and effective manner," dated Boston, Massachusetts, April 28, 1866. (See Senate Doc. No 198, Commonwealth of Massachusetts, marked D, May 1, 1867.)

4. Letters of Alpheus Hardy in behalf of board of commissioners of Commonwealth of Massachusetts, dated Boston, May 2, 1866, addressed to the chairman of the State senate committee on protection of Provincetown harbor, (H. Doc. No. 395, marked B, 1866.)

5. Report of joint special committee on Provincetown harbor, dated May 8, 1866, (H. Doc. 395, Commonwealth of Massachusetts, 1866.)

6. Report of board of commissioners for Provincetown harbor, dated Boston, December 31, 1866, enclosing letter of the board to Brevet Brigadier General H. W. Benham, dated November 20, 1866, and the reply of General Benham, of same date, (House Doc. No. 62, Commonwealth of Massachusetts, 1867.)

7. Letters of Brevet Major General H. W. Benham to his excellency A. H. Bullock, governor of the State of Massachusetts, dated Boston, February 18, 1867, with two enclosures, (Senate Doc. No. 198, Commonwealth of Massachusetts, May 1, 1867, marked A, B, and C.)

8. Letter of Brevet Major General H. W. Benham, to his excellency A. H. Bullock, governor of the State of Massachusetts, dated Boston, Massachusetts, February 27, 1867, (Senate Doc. No. 198, May 1, 1867, marked E.)

9. Report of joint committee on Provincetown harbor, dated May 9, 1867, (House Doc. No. 408, May 9, 1867.)

Also, the following maps:

1. Map of Cape Cod harbor, of 1833-'34-'35, by Major J. D. Graham, corps of topographical engineers; scale 1-10,560.

2. Coast Survey map of same harbor of 1857; scale 1-50,000.

3. Coast Survey tracing of part of the same map on the scale of 1-10,000.

4. Enlargement made at Coast Survey office of Major Graham's map to scale 1-10,000.

After the reading of the foregoing papers, and a consideration of the question involved, the board adjourned, to meet at 9 a. m. on Saturday.

The board met, pursuant to adjournment, Saturday, June 29, when, after a full discussion of the question presented for consideration, it was

Resolved That, in the opinion of the board, the course recommended in the joint report of Brigadier General H. W. Benham and Major C. E. Blunt, corps of engineers, should be carried out, modified as follows:

1. That the closing of the outlet of East harbor be deferred until such time as it is shown that active operations, from natural causes, tending to effect that object, shall have ceased; and

2. That besides the combined modes of bulkheads and jettees heretofore used to preserve Long Point, that the deposit of stone be continued, at least for

a limited extent, to further test the efficiency of that mode to effect the desired protection.

The board would further express the opinion, that in all cases where jettees are used, these structures, which, by checking the currents, cause deposits to be made, should possess, in some degree, an open and flexible character. The board approves of the plan of the bulkheads heretofore used, but hesitates to suggest, as in the case, also, of the jettees, both at Beach Point and Long Point, the number, position, or length of these works—matters which, in the opinion of the board, should be left to the judgment of the local engineer, with full authority to modify them as may seem best in the progress of the operations.

The business of the board being completed, it was duly adjourned *sine die.*

HARTMAN BACHE,
Colonel of Engineers, and Brevet Brigadier General.
H. W. BENHAM,
Colonel of Engineers, and Brevet Major General.
J. G. FOSTER,
Brevet Major General U. S. A., Lieutenant Colonel Engineers.

NOTE.—The printed legislative documents referred to accompany this report.

BOSTON, MASSACHUSETTS, *September* 17, 1867.

GENERAL: Having obtained the necessary information from the collector of the Barnstable district in relation to Provincetown—which was delayed from my supposing Provincetown to be in the Boston collection district, as it is in the Boston light-house district—I have the honor to report on certain additional matters which the circular No. 11 of the department, of June 10, 1867, states is called for by the recent appropriation laws for the works at Provincetown harbor and the sea-walls at Great Brewster, Deer, and Lovell's islands; although, as intimated in a previous letter, it is not understood that this report is expected where no disbursements have as yet taken place from the appropriations made by those laws.

Provincetown.—This port is in the Barnstable collection district, and the harbor is from four to five miles from the Highland light, at Cape Cod, one of the most important lights on this coast. The revenue collected for the last fiscal year is $3,471 22. And as to article 7 of engineer circular, I would respectfully refer to the enclosed copy of letter of Collector Swift, of Barnstable.

The abstract of proposals for contracts for work at Provincetown I forward to-day, with the new set of contracts prepared and completed by the Messrs. Blaisdells, which firm is the only one with whom contracts have as yet been made for this work.

As to the sea-walls of Deer island, Lovell's island, and Great Brewster island, I would state that they are all within from one to three miles of Fort Warren, Boston harbor, and within about the same distance of Boston light; that they are in the collection district of Boston and Charlestown; that the revenue of this district for the last fiscal year was, as reported by the collector, as per enclosed copy of his letter, $17,546,914 51; the item 7, of engineer circular No. 11, being also replied to in said letter of the collector.

The abstracts of proposals for Great Brewster island and Deer and Lovell's islands are forwarded to-day, with a letter in relation to the contracts recently made for these works.

I am, sir, very respectfully, your most obedient servant,

H. W. BENHAM,
Brevet Major General.

Major General A. A. HUMPHREYS,
Chief of Engineers.

CUSTOM HOUSE, BOSTON,
Collector's Office, September 9, 1867.

SIR: In answer to your question in letter of September 4 as to the amount of commerce and navigation at this port, I have already made a partial statement, viz:

Amount of duties received at the port of Boston and Charlestown—in which the Great Brewster, Lovell's, and Deer islands are situated—in gold, $17,344,830 53; in currency, $202,084 98.

2. The works in Provincetown are in the collection district of Barnstable, and for the amount of duties received I would respectfully refer you to Hon. Charles F. Swift, the collector. His office is in the town of Barnstable. His residence is in Yarmouth.

3. Question numbered 7 is more difficult to answer correctly. The number of foreign vessels entering this port last year was, in round numbers, 3,000, the number boarded by our officers being precisely 2,980; the number taking pilots being 1,575.

The number of arrivals other than foreign I estimate, after much inquiry, at 9,000, including, of course, many small packets and fishing vessels, which arrive many times in a year. The number of vessels that took pilots in a year, from June, 1866, to June, 1867, was 2,518. I mention this as these vessels are generally of considerable draught of water.

The tonnage of vessels registered and enrolled and licensed in this port for the year ending June 30, 1867, was, in round numbers, two hundred and ninety thousand (290,000) tons, new measurement. Accuracy is impossible, as a portion of the returns were of old measurement.

I am, very respectfully, your obedient servant,

THOMAS RUSSELL, *Collector.*

H. W. BENHAM,
Major General United States Army.

CUSTOM HOUSE, BARNSTABLE,
Collector's Office, September 13, 1867.

DEAR SIR: I am in receipt of your letter of September 12, 1867, asking for information upon several points in relation to Provincetown harbor, &c. In reply I have the honor to say—

1st. There was collected at the port of Provincetown, for the fiscal year ending June 30, 1867, from all sources, the sum of $3,471 22.

2d. As to the "amount of commerce and navigation that would be benefited by the completion of the works for the preservation of that harbor," I can only give with accuracy the local statistics of that place. There was, on the date specified, an enrolled and registered tonnage at that port of 218 vessels, comprising an aggregate of 16,229 tons. The local navigation of the port, as you are doubtless well aware, forms a very inconsiderable amount of the commerce that will be benefited by the preservation of the harbor. I have myself seen 400 vessels at anchor there at one time; and as a port of refuge it has probably no equal in the country.

Very respectfully, your obedient servant,

C. F. SWIFT, *Collector.*

Brevet Maj. Gen. H. W. BENHAM,
U. S. Engineers' Office, Boston, Mass.

P 1.

BOSTON, MASSACHUSETTS, *September* 10, 1867.

GENERAL: I have the honor to forward herewith the annual report for the last fiscal year for the Great Brewster island sea-walls and for Deer and Lovell's island sea-walls, in this harbor.

The statement A, for these and the Provincetown works, referred to near the close of the report for the latter work, already forwarded, will be sent as soon as it can be prepared from information just received from the collector of this port, and for these three works, although it is not understood to be strictly required at this time, as no disbursements have as yet been made of moneys appropriated under the law requiring that information.

Very respectfully, your obedient servant,

H. W. BENHAM,
Colonel of Engineers, Brevet Major General.

Major General A. A. HUMPHREYS,
Chief of Engineers.

BOSTON MASSACHUSETTS, *September* 6, 1867.

GENERAL: I have the honor to make the following report on the operations for the protection of Great Brewster island for the year ending June 30, 1867.

As in my last annual report a resumé of the previous operations from the time it was first commenced by myself in 1849 was given, I propose here to limit myself more closely to the operations only of the past year, and these have been mostly as was anticipated in that report.

There was on hand, as stated at the date of last report, a quantity of cut-stone facing sufficient nearly for 150 linear feet of wall, and, as was then proposed, an engagement was made for the delivery of about a like amount additional during that autumn, and a contract was made, after advertisement, for the further amount of facing for about 550 linear feet, being about all that was required for the original proposed amount of main wall; and, by another contract, the rough granite paving in rear of coping was provided for, and the stone under these different engagements have been received essentially as provided for and within the fiscal year, the delivery of the same being much facilitated by a wharf crane which I have had erected this season, and provided a portable engine for working it.

With the stone on hand the wall was recommenced in August, 1866, on the west branch of the wall of the south head, at 140 feet from the angle where Colonel Graham's work had commenced, and it was carried on about 250 feet to the end of the main line of this west branch, though not finished for the last fifty feet of the upper courses, when it was necessary to stop that part of the work and close it with a dry wing wall for the worst weather of the winter; and, during the bad weather, the men were occupied in laying the large rough paving in rear of the coping, and in filling with earth the very large space left in rear of this wall. In April the laying of the main wall at this head was resumed and carried to completion, paving, filling, and all, to a total length, in this fiscal year, of 350 running feet on west branch of south head, including the return wing wall at the west end of 104 running feet into the bank, there having been laid there during the fiscal year 5,900 feet, face measure, of wall, or about 1,680 cubic yards of faced masonry, and, with 350 yards of concrete foundation, 2,030 cubic yards were laid here, and about 550 superficial yards (in fact, *cubic* yards with the boulders beneath) of dry masonry paving in rear of the coping, and of earth work there was about 750 yards of excavation for foundation, and the mass of earth that was required to be filled in rear of this position of the wall, from the faulty location I found given to it, amounted to over 6,000 cubic yards, at a cost of over $5,000. As usual, the filling in rear is an inappreciable portion of the expense. This last expenditure, I regret to say, was caused mainly by the improper site selected so far from the bluff for this west branch of wall. And another unnecessary large expenditure has been recently necessary at the north head to throw over the wall large quantities of earth that fell upon it from the high bluff, because the walls had been run too near it in the concave portion. In the latter case, the wall built in 1853 and 1854 was run some seventy feet further northward or into the bluff on the south line of the wall of the north head than was proposed by the plans sent to the engineer department in 1850. And in the case at the south head, although there had been the abrasions by the action of the sea *for fifteen years* upon that bluff, which is thus worn away at least three feet a year as I had formerly estimated, the wall of this south branch in 1865 was placed some fifteen feet beyond or without the suggested line of 1850. Both errors, as I understand, were mainly due to the same overseer, in the absence of the senior engineer in charge, and are necessarily alluded to here to explain an expenditure of some $6,000 to $7,000 on this account, an amount in fact sufficient for about 100 running feet of main wall.

When the wall of the south head was approaching completion in June the work was resumed upon the north head, and this north wall was constructed, except the paving in rear, to the extent of 130 feet at the coping, and 150 feet at the foundation, or an average of 140 running feet by the close of June, or of the fiscal year. This added about 2,520 superficial feet of faced masonry of the main wall, or 720 cubic yards, and, including 150 yards of concrete foundation, 870 yards of wall, in addition to that at south head, or 2,900 cubic yards of masonry altogether, and about 1,000 cubic yards of earth filling was placed in addition to that at south head, or 7,000 yards of earth-filling in rear of both walls, and 610 yards excavated for foundation, or, with excavations at south head, 1,360 yards altogether.

As to the proposed operations of the present fiscal year, I would state that the work was progressing most favorably to the completion I had expected in the most economical manner. The whole front of the main bluff was protected, and the short line of wall on the north was carried to within, at the foundation, some twenty feet of the last return angle on the northwest, when I found that the appropriation of $25,000, available for this year, could be used for either labor or materials *only*, under contracts duly advertised for, and this made it necessary, early in August, to issue such advertisements, and as I fortunately obtained *one* offer, (though only one,) and that from the overseer of that work, I was able to contract, though at additional cost, for the continuance of the work from the middle of August, and without any great delay. And my expectation is that the main wall, as formerly projected, extending around the north end of the north head, and for from 350 to 380 feet on the northwest side, where, as far as the bluff is worn by the action of the elements, will be completed this autumn, and that most, if not all, the required paving in rear of the coping will be laid, and that a jetty will be built, where it appears now to be required, at the west end of the west branch of the south head.

It is hoped that the funds appropriated will suffice for this purpose, though I am as yet somewhat in doubt upon this subject, my estimates having been made for the conduct of the work as *heretofore*, with contracts for *materials* only, while in contract for labor I cannot calculate on less than an addition of 33 to 50 per cent. for the profits and risk of the construction *to furnish the same quantity of work.*

In considering the future expenditures for this work, I would state that the sums now available, I trust, will be all that is required for the work as *originally* projected, but my observation of the action of the sea between the two main walls on the east, that is, between the two bluffs, which I do not doubt were separate islands formerly, leads me to the conviction that the space between these walls, about 250 feet, should be closed by a wall of nearly or quite the same strength as those which protect the bluffs, or there will be great danger hereafter that the sea will force its way between them, cutting this island again into two parts, eddying in rear of the walls already built, and doing other damage that cannot now be especially designated.

The original plan of Colonel Thayer, (drawn by Lieutenant Welcker,) as I saw it when I commenced this work in 1849, as I now have it in my office, and as I presume is also in the engineer department, contemplated only a riprap wall of rough stone for this position, and during my first operations on this work I doubted if even this riprap would be necessary, as I saw that the high bank of shingle and boulders between these walls continued full and unbroken during all the storms we then had. I found it not to be greatly changed even on my taking charge some sixteen to eighteen months ago. But I now find that it is greatly affected by the ocean storms, being much lowered and driven inwards to the rear of the lines of the walls. I do not doubt that the facts are that until the supply of shingle, boulders, &c., from the north head, was cut off by the completion of the wall in front of its eastern face, the drift or debris from this bluff was sufficient to keep up fully this bank, and supply any wearing action of the sea. But now that this wall is finished and there is no increment from this, or in fact any other source, and the abrading action of the sea is still continuing upon this drift bank of gravel and shingle, it will undoubtedly soon level it, and force it inward, with the probability of the results stated, in any violent storm. To remedy this, I think that the sea-wall should be built up at this space between the walls of the two heads, especially as a riprap wall, if effective, would be nearly or quite as expensive from the much larger amount of stone required, which even of rough stone is now so expensive, as nearly or quite to counterbalance the cutting and fitting of stone in a wall. And for the 250 feet I estimate, as necessary, at the rate of $75 per linear foot, the lowest sum that my calculations of cost of details will permit at present prices, $22,500. This estimate is deemed sufficient, if the work is to be carried on as usual, with former appropriations, which permit the officer to use his judgment as to whether contracts should be made for labor or not. But if the amount is to be used under conditions as required by the last law making appropriations, I shall not feel safe, except with estimates at least 50 per cent. additional as necessary for the profit and risk of the contractors, or for the sum of $33,750, or, say, $34,000.

In recapitulation I would state as follows, as to the work for the protection of Great Brewster island for the past year, that as soon as the appropriation was available the work was resumed in laying the wall of the west branch of the south head, which was completed, and to the extent of 350 linear feet, and the space in the rear filled, and the paving set before the close of the fiscal year, and early in the present season the wall of the north head was resumed and completed except as to a small portion of the coping of the main or most exposed face on the east face, and, excepting the paving in rear, to the extent of about 140 linear feet, or 490 linear feet altogether on both walls by the close of the fiscal year. Contracts and engagements were also made, and mainly executed during the year, for the facing of about 700 linear feet of wall, and for most of the required paving in rear. A wharf crane was erected and a portable engine provided for the work.

And it is expected that by the close of the present working season all the main sea wall, as originally planned, or about 2,500 linear feet, altogether, will be completed, which will give ample protection to all the bluffs of the island.

No future work is required or estimated for, except for about 250 feet of wall between the two main walls as originally planned, which, from the continued wearing action of the sea, appears now to be rendered necessary, and for this estimate of $22,500, or, if the law requires the labor to be done by contract, $34,000 is asked, as ample for all that I now anticipate can be required in future.

Report of funds for Great Brewster island sea wall.

On hand with assistant treasurer at Boston, July 1, 1866......	$900 86
On hand in United States treasury from appropriations in 1866.	75,000 00
Received for sale of public property.........................	2,250 00
Total available for fiscal year ending June 30, 1867.........	78,150 86
Expended during the year....................................	$62,240 82
In the United States treasury July 1, 1867, less amount of taxes paid direct from treasury to revenue department............	$25,218 44
Of which there was due to the appropriations of other works for debts paid, as per note 6 of weekly money statement........	9,308 40
Leaving balance from former appropriation available July 1, 1867	15,910 04
Appropriation of March, 1867................................	25,000 00
Total available for the service of the year ending June 30, 1867	40,910 04

I am, sir, very respectfully, your obedient servant,

H. W. BENHAM,
Colonel of Engineers Brevet Major General.

Major General A. A. HUMPHREYS,
Chief of Engineers U. S. Army.

BOSTON, MASSACHUSETTS, *September* 7, 1867.

GENERAL: I have the honor to make the following report in reference to the operations on the sea-walls of Deer and Lovell's islands for the year ending June 30, 1867:

As stated in my last annual report, the work at Deer island has been closed from the autumn of 1865, in consequence of the exhaustion of the appropriation; the work of the season and of the year preceding, under Colonel J. D. Graham, having consisted of the erection of the boarding-house, storehouse, and stable, and the rebuilding of the sea-wall of the north head in two places, where it had been most injured, and to the extent of about 300 linear feet.

As, both in my last report and in Colonel Graham's for the previous year, the character of the sea-walls protecting the three heads or bluffs of this island are given, and in my last report the proposed manner of rebuilding them, this is not repeated here, more than to state that the old "dry-laid" sea-walls, with earth backing, are being relaid in mortar, with a good concrete backing to give them an average thickness of some eight feet, or about one-half their average height.

The work of the fiscal year was commenced on the middle head in August, 1866, as soon as practicable after the notice of the funds received as mentioned in my report in the last week of July; and though I then had the full expectation, notwithstanding unusual delays and difficulties in obtaining workmen, of being able to complete the necessary repairs upon that portion during that working season, I regret to say that, although the work was pushed forward to late in December, the difficulty and expense of removing the old wall, with the injuries received by storms, were so great that I was not able to have accomplished more than the relaying of about 180 linear feet of wall with the paving in rear, where the gap was closed up for the winter. As the season opened this year in April, and early in May, the work of relaying the wall of the middle head was resumed with a more effective working force, and it has progressed much more satisfactorily thus far, fully double the amount of work or more having been accomplished daily, so that by the close of the year, or 30th of June, about 160 linear feet additional had been relaid, with the most of the paving in rear, making, as a total of the work for the fiscal year, the rebuilding of 340 linear feet of wall, 17½ feet high by about eight feet thick, with its concrete backing of about 1⅝ yard to the linear foot.

Since the last date, however, it may be stated, though coming more properly in the report of the present fiscal year, this work has gone on with increased rapidity, so that at the *date* of this report the wall of the middle head is completed to its south extremity, and to the extent of about 200 linear feet since June, being all there now appears necessary at this bluff; the curved end or wing wall at the north end, about 290 linear feet, being in such good condition and so little exposed, that I have thus far doubted the necessity of relaying this portion.

Upon the south head also the work of rebuilding has been commenced at the north end, where it had been most injured by the storms, and at *this* date about 120 linear feet is relaid, (without the paving in rear,) and I have now little doubt, with my working force continuing as at present, that we shall be able to complete the rebuilding of the wall of this head during the present working season. The more advantageous prosecution of the work this season gives me a more sure basis for estimating for funds needed for the work yet to be accomplished, than I had at first at the date of my last report, when I thought it would be done much less, or at the close of the last season, when I had feared it would be so much more expensive than what I now think it will prove to be.

The expenditure for the working season of last year, to December 31, during which I was only able to get, as stated, about 180 linear feet of wall rebuilt, was $7,844 08, or $43 58 per linear foot; while the expenditures *this* season, (exclusive of $2,500 charged on account of one-quarter part of steamer,) to September 1, are about $11,000 for about 470 linear feet as laid this season at that date, or nearly $24 per linear foot of wall, which I trust will enable me to estimate closely for the funds necessary to be appropriated in addition to what may be on hand for the completion of the rebuilding of the wall of the north head, which, I doubt not, may be completed with the necessary funds available in two more seasons.

At Lovell's island, the funds for which are included in the same appropriation with Deer island, but little has been done this season, thus far, beyond the completion of the boarding-house, and the securing of the hay crop for future use. The increase of cost of the wall at Deer island last season, over what I expected, made me fear to make the expenditure I had proposed on this island, where less necessary, until further sums should be available. I say less necessary, because a very critical examination of the old mortar wall of this island showed that this is not at all essentially injured by the action of the sea up to this time, and there is only required, as formerly reported for this part, the placing of one or two new jettees at parts where the outer surface near the front of the wall is most abraded, and the relaying of an old jettee at its west extremity, and no special injury to be expected from delaying this work till the next season, when the erection of the new wall at the southeast bluff, for which the facing is now being prepared, can also go on as now planned.

The information of the appropriation of the $25,000 estimated for this new wall was received in the department letter of the 13th of June, and proposals were called for within the week, and a contract was completed for the furnishing of the cut-stone facing for this wall (eight feet high, at $15 the linear foot) on the 19th of July; and at the date of this report several cargoes have been already received of this stone, as well as some loads of jettee stone contracted for at the same time; and it is expected that the whole will be delivered as per contract this autumn, and that early in the ensuing year this new wall will be commenced and completed during the working season, and all the required repairs to the old wall executed.

I would state that the estimate which I had made for this wall at the south-east head of Lovell's island came out most closely, in proportion to its size, with the actual cost this year of the Great Brewster wall, as laid without contract, the facing being just about one-half the total cost of the wall; and this facing, as contracted for, will cost about $12,000, leaving thus $13,000 of my estimate for purchases of cement, obtaining concrete material, and laying the walls; that is, if done without contract, as formerly. If the work, however, is not executed in this way, but according to the law making the last appropriation, I must add fifty per cent. for risks and profits of contractors, and other incidental expenses, or $6,500 in addition to my former estimate.

For each jettee about 3,000 cubic feet of stone are required, which have been contracted for at thirty-five cents per foot, or say 33⅓, or $1,000 for the split stone for each jettee; and as the cost of laying the stone with concrete materials, &c., is about twenty per cent more than the cost of the stone. I thus find as the

estimate necessary for Lovell's island, besides the above	$6, 500
For one jettee fifty feet long, for stone and laying	2, 200
For one jettee twenty-five feet long, for stone and laying	1, 100
For relaying jettee at west end of old wall	1, 200
Add for contingencies, hauling stone, &c., from the beach, this autumn	1, 500
	12, 500

For Deer island there is shown, at the close of the recapitulation of this report, that (less the $25,000 appropriated and by estimate for Lovell's island in March, 1867) there was available July 1, 1867 .... $59, 529 30

Of which there has been expended to September 1st, about	$11, 000 00
And there is estimated to complete 292 feet at south head, this season, at $24 per foot	7, 000 00
Add for contingencies, closing work, &c	529 30
	18, 529 30

This leaves an unexpended balance for Deer island, at the close of the working season, of $41,000.

The wall of north head is 19½ feet high, two feet higher than at the other head; length of wall at that head is 1,740 feet, and less the 300 feet rebuilt by Colonel Graham. 1,440 feet to be rebuilt, at say $27 50 per linear foot, is

$39,600, or say $40,000	$40, 000
There is required for two jettees to be placed at the most exposed portions of these walls, at $2,250 each, or	4, 500
	44, 500

And neglecting the difference as to labor on the jettees, if the labor of the wall is to be executed by contract, add for profit and loss to contractors fifty per cent. on main wall	20,000
	64,500
Or less the $41,000 above reported as expected to be on hand December 1st	$23,500
Add as above for Lovell's island	12,500
Total required for both works, with labor by contract	36,000

Or if the work is executed as heretofore by days' labor, less the $26,000 estimated by contract for both works, there will only be required for the next fiscal year $9,500, or say, to complete the work, $10,000.

I would therefore state, in recapitulation, as to the work executed on Deer and Lovell's island sea-walls for the fiscal year, that the rebuilding of wall of the middle bluff was commenced in August, 1866, and by the close of June, 1867, 340 linear feet of the dry wall were securely rebuilt with mortar joints and concrete backing, with the paving of heavy flat stone twelve to fifteen feet in rear of coping; the wall being about 17½ feet high, with an average thickness of eight feet.

At the date of this report, the balance of wall requiring relaying upon that middle head, about 200 linear feet, has been completed, and about 110 linear feet of the wall of south head, of the same size, has been relaid, and it is expected that the remainder of the wall of this head will be rebuilt during the present working season.

At Lovell's island but little has been done during the fiscal year, except the completion of the boarding-house for workmen, and the call for contracts for facing stone for a new wall to the southeast head, and for jettee stone for the old wall. These contracts were completed in July, 1867, and it is expected that all the necessary stone will be delivered this autumn, and the work of building the jettees to the old wall and of constructing the new wall will be commenced as soon as the season permits in 1868.

Statement of funds received and expended on sea-walls for Deer and Lovell's islands for the fiscal year ending June 30, 1867.

On hand July 1, 1866		$605 48
Outstanding debts due from the work July 1, 1866		533 14
Funds received during the year		18,000 00
Expended for Deer island	$15,868 35	
Expended for Lovell's island	192 78	
		16,061 13
On hand in assistant treasurer's office, Boston, July 1, 1867		2,544 35
On hand in treasury undrawn, Boston, July 1, 1867, including the $25,000 estimated and appropriated for Lovell's island, and the $25,000 for Deer island, March, 1867		81,984 95
Total available for both works		84,529 30
Total proposed for Deer island, less estimate for sea-wall at Lovell's island		59,529 30

I am, sir, very respecfully your obedient servant,

H. W. BENHAM,
Colonel of Engineers, Brevet Major General U. S. Army.

Major General A. A. HUMPHREYS,
Chief of Engineers.

APPENDIX Q.

BOSTON, *September* 5, 1867.

GENERAL: I have the honor to make the following report of the operations on the works under my charge during the fiscal year ending June 30, 1867:

* * * * * * *

PRESERVATION AND IMPROVEMENT OF BOSTON HARBOR, MASSACHUSETTS.

Brevet Major General J. G. Foster was assigned to the charge of this work in May, 1867, and arrived and assumed charge on May 28, 1867. Preliminary surveys were at once made, and proposals were advertised for, for dredging a channel across the upper middle bar and the west extremity of Lovell's island, and for blasting and removing the rocks in the Narrows, (Tower Rock and Corwin Rock,) lying between Fort Warren and the Narrows light, (commonly called Bug light,) upon the extremity of Great Brewster spit. Pending the securing of the titles to the land at Long island, Gallup's island, and Point Allerton, upon which the sea-walls are to be constructed, no work has been commenced at these points, nor have proposals for their construction been invited.

It is proposed during the current year to remove by dredging about 40,000 cubic yards from the upper middle bar, so as to make a channel across that bar 300 feet in width and twenty-three feet deep at mean low water; to dredge off the southwest point of Lovell's island, and off the extremity of Great Brewster spit, removing about 145,000 cubic yards, so as to widen the channel at that point to 500 feet, at twenty-three feet depth at mean low water; to remove entirely "Tower Rock" by blasting it off to the depth of twenty-three feet at mean low water, and removing the fragments from the channel, and then to blast off and remove as much of "Corwin Rock" as the unexpended portion of the appropriation assigned to that object will accomplish. An additional amount will be required for its entire removal. The construction of the sea-walls upon Long Island head, Gallup's island, and Point Allerton, which latter is called in the laws of Massachusetts "Point Alderton," will also be commenced. For this purpose contracts will be made for the materials and labor, and for the construction of a temporary wharf at Long Island head and Point Allerton, with a view to the commencement of the work early in the spring, and for its rapid prosecution during the summer.

Expended during the fiscal year ending June 30, 1867........	$239 06
Probable amount to be expended during the fiscal year ending June 30, 1867..	299,760 94

Estimated amount required for the fiscal year ending June 30, 1869.

For the preservation of north head of Long island............	$75,000 00
For the preservation of Gallup's island......................	54,000 00
For dredging the southwest point of Lovell's island, to widen the channel to 685 feet at 23 feet depth of mean low water, as required by the project of the Boston harbor commissioners....	130,000 00
For dredging the upper middle bar to 23 feet at mean low water, and a width of 1,000 feet, as called for by the project of the Boston harbor commissioners..................................	110,000 00
For the preservation of Point Allerton	21,000 00
For blasting and removing Corwin Rock........................	24,000 00
	414,000 00

I have also the honor to report the points called for in circular No. 11 of the engineer department, series 1867, as follows, viz:

1st. The plan adopted for the works of preservation and improvement, under my charge in this harbor, is substantially that of the Boston harbor commissioners, which has met the general approval of the Chief of Engineers. The items of this plan are as follows, viz:

For the improvement of the channel across the upper middle bar, by dredging a channel 23 feet deep at mean low water, and 1,000 feet wide, at a total estimated cost of	$157,085 00
For the improvement of the channel at the Narrows, by dredging off the southwest point of Lovell's island and the extremity of Great Brewster spit, so as to widen the channel to 685 feet at 23 feet depth of water, at a total estimated cost of	188,805 00
For the improvement of the channel at the Narrows, by the removal by blasting of Tower Rock and Corwin Rock, at an estimated cost of	20,000 00
For the preservation of the north head of Long island, by the construction of a sea-wall, at an estimated cost of	150,000 00
For the preservation of the north end of Gallup's island, by the construction of a sea-wall, at an estimated cost of	103,585 63
For the preservation of Point Allerton, by the construction of a sea-wall, at an estimated cost of	70,991 87

2d. The amounts that are required for the entire and permanent completion of each work of preservation and improvement under my charge is given in the previous paragraph, No. 1, with the exception of the removal of Tower Rock and Corwin Rock, the cost of which will be $44,000.

3d. The amount that can be profitably expended upon each work during the next fiscal year is as follows, viz:

For the preservation of the north head of Long island	$75,000 00
For the preservation of Gallup's island	54,000 00
For the preservation of Point Allerton	21,000 00
For dredging the southwest point of Lovell's island and the extremity of the Great Brewster spit	130,000 00
For dredging the upper middle bar	110,000 00
For blasting Corwin Rock	24,000 00
Total for the preservation and improvement of Boston harbor for the year ending June 30, 1869	414,000 00

4th. The above works are located in the collection district of Boston and Charlestown.

5th. The above works are located at the port of Boston, Massachusetts. The improvements at the Narrows are near Fort Warren. Those at the upper middle bar are near Fort Independence; those at Point Allerton, near Boston light, and those on Long island at Long Island light.

6th. The amount of revenue collected at the port of Boston for the fiscal year ending June 30, 1867, and as communicated to me by the collector, Judge Thomas Russell, as follows, viz:

For customs in gold	$17,344,830 53
Revenue in currency	202,084 98
Total revenue	17,546,915 51

7th. By information received from the collector of this port, I am enabled to report, in regard to this item, that the number of vessels that will probably be benefited in some degree by the widening of the channel will be about 24,000, which is the aggregate number of vessels estimated to enter and leave this harbor annually by the channel through the Narrows. The amount of tonnage during the fiscal year ending the 30th of June, 1867, was as follows:

Tonnage entered from foreign ports	731, 930
Tonnage entered from domestic ports	956, 133
Tonnage cleared from foreign ports	689, 822
Tonnage cleared from domestic ports	1, 243, 366
Total tonnage entered and cleared	3, 621, 251

This amount of tonnage will no doubt be benefited, more or less, by the widening of the channel. The deepening of the channel to twenty-three feet will, the collector thinks, benefit about 3,000 vessels of an aggregate tonnage of about 1,000,000 tons.

The amount of commerce to be benefited by the proposed improvement it is difficult to estimate, as no approximation can be made of the amount of the coasting trade. The imports and exports, however, are accessible, and amounted during the last fiscal year to the following:

Total imports	$47, 288, 747
Total exports	19, 317, 874
Aggregate amount of foreign commerce	66, 606, 621

8th. The work being on June 30 at its commencement, no proposal or contracts had at that time been made.

Respectfully submitted:

J. G. FOSTER,
Bvt. Maj. Gen. U. S. A., Lieut. Col. Engineers.

Major General A. A. HUMPHREYS,
Chief of Engineers, Washington, D. C.

Q 1.

ENGINEER DEPARTMENT,
Washington, February 11, 1867.

SIR: I respectfully return herewith the letter of Hon. T. D. Eliot, acting chairman of the Committee on Commerce of the House of Representatives, of the 29th ultimo, with enclosed papers relative to the improvement of Boston harbor, referred to this department for report, and beg leave to submit the following remarks in relation thereto.

The preservation of *certain* of the islands and headlands in Boston bay is essential to the maintenance of the existing channels. So important is this considered in connection with existing and proposed permanent fortifications for the defence of the city of Boston, that the construction of sea-walls for the preservation of Deer and Lovell's and Great Brewster islands has been carried on for some time past under regular appropriations.

Estimates for the completion of these walls, amounting to $25,000 for each, are submitted in the last annual report from this office, excepting for that of Deer island, the report upon which did not reach this office in time to be included, but is now presented.

The debris from these islands form shoals that are advancing regularly into the channels, have already obstructed them, and threaten to make still more serious changes. The growth of these shoals or spits should be arrested and portions of them removed by dredging.

In addition to the islands named, works for the preservation of the north head of Long island and of Gallup's island should be at once commenced as part of the system of defence, as well as for the interests of commerce, as the debris of these islands form shoals that threaten to obstruct seriously the main channels.

With reference to the other headlands named in the petition, that of Point Allerton is of the first importance in the interests of navigation, and should be preserved in the manner indicated in the papers accompanying the petition.

Of the same general character but of less importance is the preservation of Nantasket bluff.

Respecting the south head of Long island, Moore island, and Winthrop's head, I am not prepared to report. Their preservation would prevent the deterioration of subordinate channels, convenient to local and perhaps other trade, but the closure or material shoaling of these channels would aid the defence, and if that shoaling or the process causing it should not in any way impair the main channels, I am not satisfied that the deterioration should be arrested. The question is one that will require careful investigation.

The removal of Tower Rock and Corwin Rock, which stand on the sailing line in mid-channel, and the dredging of Great Brewster and Lovell's Island spits, are works of the first importance in rendering the navigation of the main channels leading to Boston harbor secure and commodious.

The removal of the upper middle bar, though not so imperatively required for the safety of navigation, would yet be of great advantage to it. There are certain considerations, however, (which may be presented fully at some other time,) as well as those of economy, which may restrict the removal of Lovell's Island spit and the upper middle bar within the limits of the project of the Harbor Commission, (which proposes a channel one thousand feet wide at the upper middle bar, and 685 feet wide at Lovell's island, dimensions well adapted to the great commerce of Boston.) A portion of the amount of the estimate of the commission judiciously expended will be of great advantage.

I have had the benefit of a personal conference with the Harbor Commission of Boston, and an examination of their reports, plans and estimates. Under their direction extensive and careful surveys and examinations in Boston bay and harbor have been carried on for several years, and estimates of the extent and cost of the works for the preservation of the headlands and the removal of the obstructions in the channels have been prepared.

The amounts required for the fiscal year ending June 30, 1868, for the preservation of headlands and removal of obstructions in the main channels which are deemed essential for the restoration and preservation of those channels, are as follows:

For completion of sea-wall on Great Brewster island	$25, 000
For completion of sea-wall on Deer island	25, 000
For completion of sea-wall on Lovell's island	25, 000
For the preservation of the north head of Long island	75, 000
For the preservation of Gallup's island	50, 000
For the removal of Tower Rock and Corwin Rock	20, 000
For dredging Great Brewster spit, Lovell's Island spit, and upper middle bar	100, 000
For the preservation of Point Allerton	50, 000

For the completion of these works there will be required in addition for the fiscal year following that ending June 30, 1868—

For the preservation of north head Long island	$75, 000
For the preservation of Gallup's island	54, 000

For dredging Lovell's spit, if it should be found necessary to carry it to the full width of the project of the Boston Harbor Commission, 685 feet	$130, 000
For dredging the upper middle bar, if it should be found necessary to carry it to the full width of the project of the Boston Harbor Commission, 1,000 feet	110, 000
For the preservation of Point Allerton	21, 000
For the preservation of Nantasket bluff	95, 000

Very respectfully, your obedient servant,

A. A. HUMPHREYS,
Chief of Engineers.

Hon. E. M. STANTON,
Secretary of War.

APPENDIX R.

Report on the Saco river improvements for the fiscal year ending June 30, 1867, *by Brevet Brigadier General George Thom, lieutenant colonel of engineers.*

UNITED STATES ENGINEER OFFICE,
Portland, Maine, September 10, 1867.

By acts of Congres approved June 23, 1866, and March 2, 1867, appropriations were made for improving the navigation of this river. That made in 1866 (to wit, $40,000) was, as I understand, based on the report and estimates of George Davidson, esq., assistant United States Coast Survey, dated May, 1866, and the balance appropriated in March, 1867, was based on the estimates submitted by me in my report to the engineer department, dated January 5, 1867. Accompanying that report were plans and estimates for rebuilding the piers and removing the sunken rocks, amounting to $211,701 05, which included General Alexander's estimate of $192,500 for the breakwater uniting the piers (Nos. 11 and 12) near the mouth of the river.

In obedience to instructions from the department, dated March 28, 1867, (a copy of which is hereto appended, marked 3,) I issued a notice dated April 8, 1867, inviting "proposals for furnishing rough stone for a breakwater at the mouth of Saco river, Maine." A copy of the notice is hereto appended, marked 4.

Four bids were received for this work, the lowest being that of Messrs. James M. Deering & John W. Deering, of Saco, Maine, for $1 81 per ton of 2,240 pounds, as will be seen in referring to the abstract of proposals hereto appended, and marked 1. Before entering into a contract with these parties for the work, I awaited the determining of the position of the breakwater by a board of engineers to be appointed for that purpose, as instructed by department letter of the 28th of March, 1867. On the 13th of June the report of the board of engineers on this subject was transmitted to the department, a copy of which is hereto appended, marked 5. On the 14th of June I entered into a contract with Messrs. Deering, who were the lowest bidders, for furnishing the stone for the breakwater. The report of the board of engineers and contract made with Messrs. Deering having both been approved by the department, the contractors commenced the delivery of the stone on the last of June.*

In pursuance of instructions from the department, dated March 28, 1867, I advertised for proposals for removing a *sunken rock* in Saco river, a copy of the notice being hereto appended, marked 6.

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* Up to the 8th of September, 1867, about 14,000 tons of stone were delivered.

Two bids only were received for this work, the lowest being that of Mr. James Andrews, of Biddeford, for six hundred dollars, as will be seen on referring to the abstract of proposals hereto appended, marked 1.

A contract was made with Mr. Andrews, and it has been fulfilled by him.*

The amount that will be required for the entire permanent completion of the breakwater and other improvements in Saco river, as exhibited in my report dated January 5, 1867, (since printed by Congress,) is		$211, 701 05
To which add for 105,000 cubic feet additional coping of breakwater on its exterior face down to low-water mark, at 50 cents per cubic foot	$52, 500 00	
10 per cent. for contingencies	5, 250 00	
		57, 750 00
		269, 451 05

Say, $270, 000.

Total amount appropriated by acts of Congress approved March 2, 1867, and June 23, 1866, $80,000; amount required for completion of work, $150,000, of which $75,000 can be profitably expended upon it during the next fiscal year.

The works for the improvement of the navigation of Saco river are located in the collection district of Saco and near the ports of Saco and Biddeford, Maine. The nearest *light-house* is on Wood island, opposite the mouth of Saco river, and the nearest forts are those in Portland harbor.

The amount of revenue collected at Saco, (the port of entry,) as furnished by the collector, was for the fiscal year ending June 30, 1867, $755 76.

As to the amount of commerce and navigation that would be benefited by the completion of these works of improvement I will here repeat the information kindly furnished by Mr. Edward Eastman, then United States deputy collector, contained in my special report of the 5th of January last, to wit:

"At the inner harbor, which is inside the bar, we have averaged about forty coal vessels and about one hundred and fifty to two hundred vessels in the coasting business, bringing general merchandise for this place and Biddeford and the back country, and carrying out timber, &c., exclusive of what comes by railroad. This port is the entry for the supplies, including the back districts, of a population of about thirty thousand, and is the natural shipping port of the timber interest of nearly the whole of York county, except some towns in the extreme western part which lie near Portsmouth, New Hampshire.

"In addition to our former business since this appropriation was made an ice company has been formed by persons from Philadelphia in connection with residents of Saco, who are making arrangements for the exportation of ice. They are erecting large store-houses on or near one of our wharves, and say they will employ about one hundred coasting vessels in the ice-carrying trade the coming season.

"The Saco Ship-building Company also has just fairly started, and will give a new impetus to our commerce, as they obtain a considerable portion of their timber from the southern markets."

The improvements now in progress may be regarded as permanent, and such as after completion will not require further expenditure.

The papers described as follows are hereto appended:

1. Abstract of proposals for each work, with name of bidders, &c.

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* On the 24th of July, 1867, another contract for the entire removal of the sunken rocks at Little islands was made with Mr. James M. Andrews, of Biddeford, Maine, for the sum of $2,000. On the 8th of September, 1867, the contract was fulfilled.

2. Abstract of contracts for each work, with name of contractors.
3. Copy of instructions from the engineer department.
4. Copy of notice inviting proposals for breakwater.
5. Copy of report of board of engineers.
6. Copy of notice inviting proposals for removing sunken rock.

GEORGE THOM,
Lieut. Colonel of Engineers, Brevet Brig. Gen. U. S. A.

No. 1.—*Abstract of bids received for the improvement of Saco river, Maine.*

Nature of work.	No. for reference.	Names of bidders.	Amount bid for.	Price.
Furnishing rough stone for breakwater.	1	Wm. Courtenay, Baltimore, Maryland.	25,000 tons	$2 23 per 2,240 lbs.
	2	Isaac Hamilton, Cumberland, Maine.	25,000 tons.	2 15 per 2,240 lbs.
	3	Jas. Andrews, W. G. Gooch & Co., Goodwin & Buck, Ira Andrews, W. & J. Moore, all of Biddeford, Maine.	50,000 tons, (more or less.)	1 83 per 2,240 lbs.
	4	Jas. M. Deering and John W. Deering, of Saco, Maine.	50,000 tons, (more or less.)	1 81 per 2,240 lbs.
For removing sunken rock.	1	Ira Andrews, of Biddeford, and Jas. M. Deering, of Saco.	Whole work.	$2,360 00
	2	Jas. Andrews, of Biddeford, Maine.	Whole work.	600 00

GEORGE THOM,
Lieut. Col. of Engineers, Brevet Brig. Gen. U. S. Army.

No. 2.—*Abstract of contracts made for the improvement of Saco river, Maine.*

Nature of work.	No. for reference.	Names of contractors.	Quantity.	Price.
Furnishing rough stone for breakwater.	1	Jas. M. Deering and John W. Deering, of Saco, Maine.	50,000 tons, (more or less.)	$1 81 per 2,240 lbs.
For removing sunken rock.	2	Jas. Andrews, of Biddeford, Maine.	Whole work.	$600 00

GEORGE THOM,
Lieut. Col. of Engineers, Brevet Brigadier General.

No. 3.

ENGINEER DEPARTMENT,
Washington, March 28, 1867.

COLONEL: Your letter of the 26th instant has been received. Your recommendation that the funds appropriated for the improvement of the Saco river be applied to the construction of a breakwater uniting piers Nos. 11 and 12, except so much as may be required to rebuild pier No. 6, and to remove the sunken rock in the channel at Little's island, and (should it be hereafter desirable) to rebuild pier No. 8 at "Ferry Narrows," is approved, with the condition that the position of the breakwater shall first be determined by a board of engineers. You can proceed, however, to advertise for proposals for furnishing the necessary materials for the work, in order that no unnecessary delay may occur in its vigorous prosecution at as early a day as practicable.

Very respectfully, your obedient servant,

A. A. HUMPHREYS,
Brig. Gen. and Chief of Engineers, Maj. Gen. of Vol.

Brevet Colonel GEORGE THOM, U. S. A.,
Lieut. Colonel of Engineers, Portland, Maine.

No. 4.

Proposals for furnishing rough stone for a breakwater at the mouth of Saco river, Maine, will be received at this office until 10 o'clock a. m , on Tuesday, the 30th instant.

The quantity required, under recent appropriations, will be fifty thousand tons, more or less. The stone must be of suitable size and strength, and be deposited in such places and in such manner as may be directed by the superintending engineer, in conformity with the plans adopted.

The delivery of the stone must commence as soon as practicable after the approval of the contract, and be completed on or before the first day of December next. Persons in making proposals will state the price per ton (of 2,240 pounds) of stone delivered and deposited in position; the weight to be ascertained at the expense of the contractor and to the satisfaction of the superintending engineer.

Proposals will be considered for one-half or for the whole of the above-named amount.

Should any person find it impracticable to undertake the whole job in the time above specified, they are requested to state in their proposals the earliest period (to be not later than the 1st of July, 1868) in which they will contract to complete it, with the understanding that not less than 35,000 tons will be delivered on or before the first day of December next.

Each proposal must be accompanied by a written guarantee signed by two responsible persons, in the required form, that the bidder will, when called on, if his proposal be accepted, enter into a contract and bond, with good and sufficient security, (the sureties and their places of residence to be named in the proposal,) for the true and faithful performance of his contract. The contract will be awarded to the lowest responsible bidder, and be subject to the approval of the Secretary of War.

The undersigned, however, reserves the right to exclude the bids of any persons who there is reason to believe will not faithfully and promptly perform the contract; any informal bids, as well as those that are above a responsible price for the work; and no member of Congress, officer or agent of the government, nor any person employed in the public service, shall be admitted to any share in the contract, or any benefit which may arise therefrom.

Payments will be made monthly—20 per cent. to be reserved therefrom until the whole work is furnished, and to be forfeited in the event of the non-fulfilment of the contract in the time and manner as therein required.

Persons desiring to make proposals will please call on the undersigned at his office, in Morton block, on Congress street, for forms of same, and for more definite information, if desired, and, on transmitting them, will indorse thereon, "Proposals for improvement of Saco river."

GEORGE THOM,
Brevet Brigadier General, U. S. Army.

UNITED STATES ENGINEER OFFICE,
Portland, Maine, April 8, 1867.

No. 5.

Proposals for removing a sunken rock in Saco river, Maine.

Proposals will be received at the office until 2 o'clock p. m., on Friday, the 17th instant, for removing *a sunken rock* in mid-channel of Saco river, at Little island. The rock has an irregular shape, being about seventeen feet long by five wide, and six feet in height. The depth of water in the channel at this place is from eight to nine feet at mean low-water. The rock must be *entirely* removed from the channel, and its fragments be deposited on the site of the breakwater at the mouth of the river. The work must be commenced immediately after the approval of the contract, and be completed not later than four weeks from that period. In making proposals bidders will state the price for which they will perform the job. Each proposal must be accompanied by a written guarantee, signed by two responsible persons in the required form, that the bidder will, when called on, if his proposal be accepted, enter into a contract and bond with good and sufficient security (the sureties and their places of residence to be named in the proposal) for the true and faithful performance of his contract The contract will be awarded to the lowest responsible bidder and be subject to the approval of the Secretary of War. The undersigned, however, reserves the right to exclude the bids of any persons who there is reason to believe will not faithfully and promptly perform the contract; also any informal bids, as well as those that are above a reasonable price for the work; and no member of Congress, officer or agent of the government, nor any person employed in the public service, shall be admitted to any share in the contract or any benefit which may arise therefrom. Payment will be made on the satisfactory completion of the work.

Persons desirous to make proposals will please call on the undersigned, at his office in Morton block, on Congress street, for forms of same, and for more definite information, if desired; and on transmitting them, will indorse thereon "Proposals for removing rock in Saco river, Maine."

GEORGE THOM,
Brevet Brigadier General U. S. A.

UNITED STATES ENGINEER OFFICE,
Portland, Maine, May 7, 1867.

R 1.

UNITED STATES ENGINEER'S OFFICE,
Portland, Maine, June 13, 1867.

GENERAL: I have the honor to transmit herewith a report of board of engineers, convened in compliance with Engineer Order No 43, dated June 6, 1867, "for the consideration of the plan proposed for, but especially to determine the proper position and extent of, the breakwater at the mouth of the Saco river." Also, to forward herewith a copy of the plan recommended by the board for adoption.

I am, very respectfully, your obedient servant,

GEORGE THOM,
Lieut. Col. Corps of Engineers, Brevet Brig. Gen. U. S. Army.

Major General A. A. HUMPHREYS,
Chief of Engineers, U. S. Army, Washington, D. C.

In pursuance of Engineer Order No. 43, dated June 6, 1867, the board of engineers—consisting of Brevet Brigadier General Hartman Bache, colonel of engineers; Brevet Brigadier General George Thom, lieutenant colonel of engineers; Brevet Colonel Thomas L. Casey, major of engineers—assembled at Saco, Maine, on Tuesday, June 11, 1867, "for the consideration of the plans proposed for, but especially to determine the proper position and extent of, the the breakwater at the mouth of Saco river."

The board made a personal examination of the river, the channels, piers, and bars at its mouth, after which it adjourned, to meet at Portland, Maine, at 9 a. m. Wednesday, June 12, 1867.

The board, pursuant to adjournment, met at Portland, Maine, at 9 a. m. Wednesday, June 12, 1867; present, all its members.

All the information relating to this work in the possession of Brevet Brigadier General George Thom, lieutenant colonel of engineers, was laid by him before the board, including the following papers, viz: Notes on the piers in the Saco river, Maine, submitted by Captain J. G. Barnard, corps of engineers, dated October 18, 1853, with accompanying drawings; report of Mr. George Davidson, assistant, United States Coast Survey, dated May 19, 25, and 27 1866, with accompanying maps; and report of Brevet Brigadier General B. S. Alexander, lieutenant colonel of engineers, dated October 16, 1866, with accompanying plans.

After a free discussion of the various plans presented, it was—

Resolved, That this board accepts the plan proposed by Brevet Brigadier General B. S. Alexander, lieutenant colonel corps of engineers, for the breakwater at the mouth of Saco river, Maine, as set forth in his report of October 16, 1866, and recommends that it be constructed to the extent and in the position therein laid down. At the same time, the board would leave it to the direction of the constructing engineer to make such changes in the inner slope of the cross section of the breakwater as may be found expedient.

The board having concluded the duties for which it was convened, adjourned *sine die.*

THOMAS LINCOLN CASEY,
Major of Engineers and Brevet Col. U. S. Army.
GEORGE THOM,
Lieut. Col. of Engineers, and Brevet Brig. Gen. U. S. Army.
HARTMAN BACHE,
Colonel of Engineers, Brevet Brigadier General.

R 2.

Report on the survey of Richmond's island, Cape Elizabeth, Maine, for the year ending June 30, 1867, by Brevet Brigadier General George Thom, lieutenant colonel corps of engineers.

UNITED STATES ENGINEER OFFICE,
Portland, Maine, September 10, 1867.

The act of Congress approved March 2, 1867, providing for the survey of this locality, does not state its purpose; but as a small appropriation has heretofore been made for building a breakwater connecting Richmond's island with the mainland, and as an attempt was made about the years 1853 and 1854 to construct such a work, for the purpose of making a harbor of refuge at that place, I have caused a survey to be again made with a view to submitting a plan and estimate of the cost of such a work as, in my opinion, would be best adapted to that purpose.

The bar connecting the island and the mainland is, doubtless, caused by the meeting of the currents passing around both the eastern and the western points of the island; that portion of the bar nearest to the island being, as it appears, fixed and unchanged in its position, while that nearest the mainland is moved a short distance from the westward to the eastward, as the east or west winds may respectively predominate. Its general position, however, is on a line connecting the two nearest points of the island and mainland.

A breakwater constructed on this bar, uniting these two points, would form a good harbor of refuge, affording a safe anchorage and good holding ground, with the wind from any point between north and southwest; and as the winds from the northward and eastward bring the most violent and destructive gales which occur on this coast, there can be no question as to the very great importance and advantage of such a work at this place, in thus affording refuge to vessels which are prevented by these storms from entering Portland harbor or other places on this part of the coast.

The breakwater, to be permanent, should, in my opinion, be built of stone. The proposed location with its longitudinal section and a general cross section are exhibited on the accompanying map.

As the capping of this work would greatly increase its cost, it is not estimated for; but should it hereafter be found necessary to resist the action of the sea, it can be added. It is probable, however, that it will not be necessary, as the proposed structure will prevent the shifting of the bar and increase its foundation, and will thereby acquire additional strength.

There is an abundance of rubble stone to be found on Cape Elizabeth, which will reduce the probable cost of the work.

To construct it there would be required 68,000 tons of rubble stone, which, at $1 25 per ton, would cost	$85,000 00
Add 10 per cent. for contingencies	8,500 00
Total	93,500 00

Of which $50,000 can be profitably expended upon it during the next fiscal year.

The following information is furnished in compliance with the requirements of the act providing for this survey, viz:

The proposed work is located in the collection district of Portland and Falmouth; it is distant from Portland, the port of entry, by water about 12 miles, and eight by land; and from Saco, another port of entry, about 13 miles by water and about the same distance by land.

Cape Elizabeth light-houses lie about two miles to the northeast, and Wood

Island light-house (opposite the mouth of Saco river) about eight miles to the south of this locality. The nearest forts are those in Portland harbor, viz: Forts Gorges, Preble, and Scammel.

At Portland, the nearest port of entry, the amount of revenue collected for the fiscal year ending June 30, 1867, was—

Duties on importations	$986,318 17
Tonnage and hospital money	47,574 37
Total	1,033,892 54

The amount of duties assessed at this port on merchandise entered during the same period, which includes, in addition to the foregoing, duties on goods in transitu for the British provinces, and on those entered for other ports in bond, was $7,682.650.

The amount of commerce and navigation that would be benefited by the completion of this work may be inferred from the following information furnished by Hon. J. Washburn, jr., United States collector at Portland, Maine: "The number of foreign entrances and clearances at Portland, Maine, for the year ending June 30, 1867, was 1,171; the number of domestic entries and clearances during the same period was 1,430." But this statement exhibits but a part of the commerce that would be benefited by the work referred to in Portland harbor and at Richmond's island.

The number of vessels that put into Portland harbor and that at Richmond's island during the year, which do not make entry at Portland, is very large.

GEORGE THOM,
Lieut. Col. Corps of Engineers, Bvt. Brig. General.

R 3.

Report on the extension of the breakwater in Portland harbor, Maine, by Brevet Brigadier General George Thom, lieutenant colonel corps of engineers, for the fiscal year ending June 30, 1867.

UNITED STATES ENGINEER OFFICE,
Portland, Maine, September 10, 1867.

By an act of Congress, approved June 23, 1866, an appropriation was made for this work amounting to $105,111 05. This is the amount that was estimated for the entire completion of the work.

In November, 1866, I relieved Brevet Brigadier General B. S. Alexander, lieutenant colonel of engineers, from the charge of this work. He had already caused soundings to be made for a distance of 180 feet from the outer end of the breakwater, and had submitted a plan for its extension. As this involved a departure from the original plan, I was instructed by the department, (see Appendix A,) before determining upon the plan of this work, to make a full series of current and tidal observations at such points in the harbor as "might be found useful aids in arriving at proper conclusions."

After repeated experiments it was found impracticable to make the current observations called for during the winter, owing to the winds, storms, and floating ice. The tidal observations, however, were continued day and night for two or three months, and satisfactory results obtained.

A board of engineers appointed by the department order of June 6, 1867, "to investigate the question of the proper direction and length of the extension of the breakwater," approved the plan recommended by General Alexander.

Before further action thereon by the department, the current and tidal observations called for are to be furnished.* Having been instructed under date of June 27, 1867, to have the breakwater repaired, and the unfinished portion southwest of the light-house and the shore end completed, I advertised for proposals for the same.†

The amount already appropriated for this work is deemed sufficient for its completion, and it is probable that it will be completed during the next fiscal year. This work is situated in the collection district of Portland and Falmouth. It is in Portland harbor, has a light-house built on its outer extremity, and is in the immediate vicinity of Fort Gorges, Fort Preble, and Fort Scammel. The amount of revenue collected for the fiscal year ending June 30, 1867, was, as stated by the United States collector, as follows, viz:

Duties on importations	$986,318 17
Tonnage and hospital money	47,574 37
Total	1,033,892 54

The amount of duties assessed at this port on merchandise entered during the same period, which includes, in addition to the foregoing, duties on goods in transit to the British provinces and on those entered for other ports in bond, was $7,862,650.

The amount of commerce and navigation that would be benefited by the completion of this work, as also stated by the collector, is as follows, viz: "The number of foreign entrances and clearances at this port for the year ending June 30, 1867, was 1,171; the number of domestic entries and clearances during the same period was 1,430. But this statement exhibits but a part of the commerce that would be benefited by the work referred to. The number of vessels that put into this harbor and that at Richmond's island during the year, which do not make entry at Portland, is very large."

The proposed completion of this work may be regarded as permanent, and after completion will not require further expenditure.

GEORGE THOM,
Lieut. Colonel of Engineers, Brevet Brig. Gen. U. S. A.

A.

ENGINEER DEPARTMENT,
Washington, November 5, 1866.

COLONEL: Brevet Brigadier General Alexander, in his report upon the breakwater at Portland, expresses an opinion adverse to its "extension further than is necessary to give it a proper termination," and this would involve a departure from the original plan. It is suggested that before determining upon it, a full series of current and tidal observations might be found useful aids in arriving at proper conclusions. Current observations might be made at the following positions, viz:

1st. Middle of main channel, between the end of the breakwater and Fort Gorges.

2d. Mid-channel, off Pomroy's Rock.

3d. Off Fort Gorges, in the middle of the channel from Casco bay that runs west of Fort Gorges.

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* In July and August, 1867, a very minute and satisfactory series of current and tidal observations were made by Assistant Engineer Mr. A. Grant Childs, it having been the earliest opportunity for so doing.

† Contracts have been made for this work, and operations were commenced on the 1st of September, 1867.

4th. On the Middle Ground.

5th. In mid-channel between the Middle Ground and the end of the breakwater.

6th. In mid-channel of inner harbor.

Tidal observations might be taken at the same time with the current observations, to extend through at least one lunation, as follows, viz:

1st. At the end of the breakwater.

2d. At Fort Gorges.

3d. At the Atlantic and St. Lawrence railroad bridge.

4th. At Portland bridge.

Very respectfully, your obedient servant,

A. A. HUMPHREYS,
Chief of Engineers, Brig. and Brevet Maj. Gen.

Brevet Colonel GEORGE THOM, U. S. A.,
Lieut. Col. of Engineers, Portland, Me.

R 4.

UNITED STATES ENGINEER OFFICE,
Portland, Me., June 13, 1867.

GENERAL: I have the honor to transmit herewith the report of the board of engineers convened under Engineer Order No. 43, dated June 6, 1867, to investigate the question of a proper direction and length of the extension of the breakwater.

A copy of the drawings and plans recommended for adoption will also be forwarded as soon as completed.

These drawings will be duplicates of those accompanying the report of Brevet Brigadier General B. S. Alexander, lieutenant colonel corps of engineers, dated September 25, 1866, to which, for the present, the department is respectfully referred.

I am, very respectfully, your obedient servant,

GEO. THOM,
Lieut. Col. Corps of Engineers, Brevet Brig. Gen. U. S. A.

Major General A. A. HUMPHREYS,
Chief of Engineers U. S. A., Washington, D. C.

In pursuance of Engineer Order No. 43, dated June 6, 1867, the board of engineers, consisting of Brevet Brigadier General Hartman Bache, colonel of engineers; Brevet Brigadier General George Thom, lieutenant colonel of engineers; Brevet Colonel Thomas L. Casey, major of engineers, assembled at Portland, Maine, on Wednesday, June 12, 1867, to investigate the question of the proper direction and length of the extension of the breakwater.

The board made a personal examination of the breakwater; after which it adjourned to meet at 10 a. m., June 13, 1867.

The board, pursuant to adjournment, met at 10 a. m., June 13, 1867; present, all its members.

All the information relating to this work in the possession of Brevet Brigadier General George Thom, lieutenant colonel of engineers, was laid by him before the board, including the following papers, viz:

Three letters from Major Z. B. Tower, corps of engineers, to the engineer department, dated November 30, 1852, January 17, and May 16, 1853; report of Brevet Brigadier General B. S. Alexander, lieutenant colonel of engineers, to the engineer department, dated September 25, 1866, with accompanying drawings; United States Coast Survey map of Portland harbor, 1862; tidal and current observations in Portland harbor, made in the winter of 1866, under the direction of Brevet Brigadier General George Thom.

After a full discussion of the various plans presented, it was

Resolved, That this board approves the plan proposed by Brevet Brigadier General B. S. Alexander, lieutenant colonel of engineers, "of the proper direction and length of extension of the breakwater" in Portland harbor, as set forth in his report of September 25, 1866, and accompanying drawings, and does recommend that the work be completed in accordance with the plan.

The board deems it proper to call the attention of the department to the fact that among the papers laid before it there was nothing showing the original plan of the work, or when and under whose direction it was built, nor the reports and estimates of the late Colonel J. D. Graham, corps of engineers, upon which the present appropriation was based.

The board having completed the duties for which it was convened, adjourned *sine die*.

HARTMAN BACHE,
Colonel of Engineers and Brevet Brig. Gen.
GEO. THOM,
Lieut. Col. of Engineers and Brevet Brig. Gen.
THOMAS L. CASEY,
Major of Engineers and Brevet Col. U. S. A.

R 5.

Report on the examination or survey of Kennebec river above Gardiner, Maine, for the year ending June 30, 1867, by Brevet Brigadier General Thom, lieutenant colonel of engineers.

UNITED STATES ENGINEER'S OFFICE, PORTLAND, MAINE,
September 10, 1867.

On my being placed in charge of this work in November, 1866, I commenced a careful survey of Kennebec river, extending from Shepard's Point, at Hallowell, up to Augusta, Maine, with a view to determine the obstructions to navigation between those points, for the improvement of which Congress, by an act approved June 23, 1866, made an appropriation of twenty thousand dollars.

The result of this survey, together with the maps and estimates for the improvement of the river between those points, were submitted to the department in my special reports of the same, dated January 21 and 29, 1867. By an act approved March 2, 1867, Congress made an additional appropriation, based on my estimate sufficient for the entire completion of the improvements recommended by me to be made between Shepard's Point and Augusta. In an examination of the river since made between Shepard's Point and Gardiner, I ascertained that there are two shoals, known as "Hinkley's shoal and Brown's Island shoal."

Hinkley's shoal is about one-half a mile below Shepard's Point. It extends across the river and has about five and a half feet of water on it at low water, and is about 300 feet wide.

Brown's Island shoal is about one and a quarter mile below Shepard's Point, and extends from Brown's island across to Brown's Island wharf, on the left bank of the river. It is about 150 feet wide, and has about six feet of water on it at low water. In addition to these shoals, there is a rock in the river abreast Grant's ship yard, which should be removed.

To excavate a channel through these shoals of the same width and depth as that now being excavated through the shoals above would require about 5,000 cubic yards of dredging, which at 45 cents per cubic yard would cost	$2,250 00
To remove rock in the river, (say)	450 00
	2,700 00
Adding 10 per cent. for contingencies	270 00
	2,970 00

Say $3,000.

A more careful survey of this river soon to be made between Gardiner and Shepard's Point may modify this estimate a little, but probably will not increase it. The amount above named (to wit, $3,000) will probably be all that is required for the entire completion of the improvement of the river between those points, all of which can be profitably expended upon the work during the next fiscal year.

The following information is furnished in compliance with the act of Congress providing for this survey, viz:

The proposed improvements are located in the collection district of Bath, Maine.

Bath is the only port of entry in this district; it is situated on Kennebec river, about twenty-five miles below Gardiner, Maine.

The United States arsenal is located at Augusta, on the left bank of the Kennebec, about six miles above Gardiner, and Fort Popham is at the mouth of the Kennebec, about twelve miles below Bath.

Seguin and Pond Island light-houses are near the mouth of this river.

The amount of revenue collected at this port of entry (Bath) during the fiscal year ending June 30, 1867, was $40,820 56.

The amount of commerce and navigation that would be benefited by the completion of the proposed river improvements, as stated by the United States collector of customs at Bath, is copied from my special report on this subject, dated January 21, 1867, as follows: "The whole tonnage of this district is something over 80,000 tons, all of which would be more or less benefited by the improvement of the navigation of the Kennebec, the works near the mouth of the river, such as Fort Popham. Seguin and Pond Island lights are designed for the benefit of the whole district."

The improvement proposed between Augusta and Shepard's Point, in Hallowell, would more particularly benefit vessels bound to and leaving those ports, and the completion of the work would doubtless cause great increase of business at those points.

One steamboat has plied between Hallowell and Boston, and one between Gardiner and Boston, during the past season, carrying many passengers and much freight. These steamers would extend their trips to Augusta if the contemplated improvement is made. The arrivals at Hallowell and Augusta in 1865 were 42 coastwise and 5 foreign vessels. At Gardiner, four miles below Shepard's Point, the arrivals were 223 coastwise and 10 foreign vessels.

GEORGE THOM,

Lieut. Col. of Engineers, Brevet Brig. Gen. U. S. A.

R 6.

Report on the improvement of Kennebec river, in the State of Maine, between Shepard's Point and Augusta, by Brevet Brigadier General George Thom, lieutenant colonel corps of engineers, for the fiscal year ending June 30, 1867.

UNITED STATES ENGINEER OFFICE,
Portland, Maine, September 10, 1867.

This work consists in straightening and deepening the channel of Kennebec river, through the several shoals obstructing its navigation, between Shepard's Point and Augusta, Maine.

The plan proposed and recommended by me in my special reports and estimates, dated January 21 and 29, 1867, is to dredge out a channel (through all the shoals) having a width of seventy-five feet on the bottom, with sides having a slope of two feet for one foot rise, the depth to be eight feet up to the Hallowell, and seven feet thence to Augusta, at the lowest stage of the river. To effect this about 100,000 cubic yards of dredging will be necessary, which, at forty-five cents per cubic yard, would cost $45,000
Add ten per cent. for contingencies 4,500

49,500

Say $50,000.

By an act of Congress approved June 23, 1866, there was appropriated for this work	$20,000
And again, by an act approved March 2, 1867, there was an additional appropriation, based on my estimates for January 21 and 29, 1867	30,000
Total	50,000

which is estimated to be sufficient for completing the proposed improvement. The nature of the bottom is such that it is not probable that any material change will occur in the channel, when once properly dredged.

Under authority of the department, dated February 18 and March 20, 1867, I advertised three separate times for proposals for dredging the proposed channel through the shoals at Hallowell, before a reasonable and satisfactory bid was received—the bids ranging from forty cents to one dollar thirty-five cents per cubic yard, as will be seen on referring to the abstract of same hereto appended, marked No. 1. A copy of the last notice, inviting proposals, is hereto appended, marked No. 3.

Mr. Augustus R. Wright, of Geneva, New York, having been the lowest bidder, a contract was made, May 23, 1867, with him, to perform the work at forty cents per cubic yard, and to commence operations on or before the 1st of August, 1867. The contract requires Mr. Wright to complete his work on or before the 1st of August, 1868.

The following information, called for by the act of Congress making appropriation for this work, is furnished, viz:

The improvements are located in the collection district of Bath, Maine.

Bath, Maine, is the only port of entry in this collection district, and is situated on the Kennebec river, about thirty miles below Hallowell.

The United States arsenal is located at Augusta, on the left bank of the Kennebec; and Fort Popham is about twelve miles below Bath, at the mouth of the river. Seguin and Pond Island light-houses are near the mouth of this river.

The amount of revenue collected at this port of entry (Bath) during the fiscal year ending June 30, 1867, was $40,820 56.

The amount of commerce and navigation that would be benefited by the completion of the proposed river improvements, as stated by the United States collector of customs at Bath, is copied from my special report on this subject, dated January 21, 1867, as follows: "The whole tonnage of this district is something over 80,000 tons, all of which would be more or less benefited by the improvement of the navigation of the Kennebec. The works near the mouth of the river, such as Fort Popham, Seguin, and Pond Island lights, are designed for the benefit of the whole district. The improvement proposed between Augusta and Shepard's Point, in Hallowell, would more particularly benefit vessels bound to and leaving those ports, and the completion of the work would doubtless cause great increase of business at those points."

One steamboat has plied between Hallowell and Boston, and one between Gardiner and Boston, during the past season, carrying many passengers and much freight. These steamers would extend their trips to Augusta, if the contemplated improvement is made. The arrivals at Hallowell and Augusta, in 1865, were forty-two coastwise and five foreign vessels. At Gardiner, four miles below Shepard's Point, the arrivals were 223 coastwise and ten foreign vessels.

The following described papers are appended hereto, to wit:

1. Abstract of proposals.
2. Abstract of contracts.
3. Copy of notice inviting proposals for dredging.

GEORGE THOM,
Lieut. Col. of Engineers, Brevet Brig. Gen. U. S. A.

No. 1.—*Abstract of proposals received for the improvement of Kennebec river, Maine.*

Nature of work.	Names of bidders.	Amount bid for.	Price.
FIRST SERIES OF BIDS.		*Whole work.*	
Dredging a new channel through Shepard's Point shoal and Hallowell shoal.	Bernard Daly, Portland, Maine.	45,000 cubic yards, (more or less.)	$1 35 per cubic yard.
	George P. Wescott, Portland, Maine.	45,000 cubic yards, (more or less.)	1 19 per cubic yard.
SECOND SERIES OF BIDS.			
	Chas. Woolley, Boston, Mass.	45,000 cubic yards, (more or less.)	1 00 per cubic yard.
THIRD SERIES OF BIDS.			
	A. B. Cooley, & Co., Philadelphia, Pa.	45,000 cubic yards, (more or less.)	1 10 per cubic yard.
	Chas. Woolley, Boston, Mass.	45,000 cubic yards, (more or less.)	90 per cubic yard.
	Jonas H. Perley, Portland, Maine.	45,000 cubic yards, (more or less.)	88 per cubic yard.
	Thomas J. Strong. Sandy Hill, N. Y.	45,000 cubic yards, (more or less.)	65 per cubic yard.
	A. R. Wright, Geneva, N. Y.	45,000 cubic yards, (more or less.)	40 per cubic yard.

GEORGE THOM,
Lieutenant Colonel of Engineers, Brevet Brigadier General.

No. 2.—*Abstract of contracts made for the improvement of Kennebec river, Maine.*

Nature of work.	Name of contractor.	Quantity.	Price.
Dredging a new channel through Shepard's Point shoal and Hallowell shoal.	Augustus Wright, Geneva, N. Y.	Whole work, 45,000 cubic yards, (more or less.)	$0 40 per cubic yard.

GEORGE THOM,
Lieut. Col. Corps of Engineers, Brevet Brig. Gen. U. S. Army.

No. 3.

Proposals for dredging a new channel through Shepard's Point shoal and Hallowell shoal, in the Kennebec river, at Hallowell, Maine.

U. S. ENGINEER OFFICE,
Portland, Maine, May 6, 1867.

Proposals will again be received for this work (those heretofore received being unreasonably high) until 2 o'clock p. m. on Saturday, the 18th instant.

The object of the proposed improvement is to obtain a clear channel, not less than seven feet deep at low water and seventy-five feet wide on the bottom, with sides having a slope of two feet to one foot rise.

The channel will *first* be excavated through Shepard's Point shoal for the distance of about 450 yards, requiring 20,000 cubic yards of excavation, more or less, and *afterwards* through Hallowell shoal, for a distance of 575 yards, requiring 25,000 cubic yards of excavation, more or less. This amount of excavation may be increased or diminished, as the engineer in charge may direct, after further examination of the river.

The material taken from the shoal is to be deposited in the river in such manner as may be required by the engineer in charge and in such localities as may be designated by him, not exceeding 650 yards in distance from Shepard's Point above and below it.

In making proposals, bidders must state the price *per cubic yard actually excavated,* to be measured in the scows, with the understanding that the *price stated* is to include the depositing of the material taken out, in such localities as may be designated within the limits above named.

The work must be commenced as soon as practicable after the approval of the contract, and be completed not later than the 1st of August, 1868, with the understanding that not less than 25,000 cubic yards must be dredged on or before the 20th of November next.

Each proposal must be accompanied by a written guarantee, signed by two responsible persons, in the required form, that the bidder will, when called on, if his proposal be accepted, enter into a contract and bond, with good and sufficient security, for the true and faithful performance of his contract.

The contract will be awarded to the lowest responsible bidder, and be subject to the approval of the Secretary of War.

The undersigned, however, reserves the right to exclude the bids of any persons who there is reason to believe will not faithfully and promptly perform the contract; also, any informal bids, as well as those that are above a reasonable price for the work; and no member of Congress, officer or agent of the government, nor any person employed in the public service, shall be admitted to any share in the contract or any benefit which may arise therefrom.

Payment will be made monthly; twenty per cent. to be reserved therefrom until the whole work is finished, and to be forfeited in the event of the non-fulfilment of the contract in the time and manner as therein required.

Persons desiring to make proposals will please call on the undersigned at his office, in Morton block, on Congress street, for forms of same and for more definite information, if desired; and on transmitting them, will indorse thereon, "Proposals for improvement of Kennebec river."

GEORGE THOM,
Brevet Brigadier General U. S. Army.

R 7.

U. S. ENGINEER OFFICE,
Portland, Maine, January 21, 1867.

GENERAL: I have the honor to transmit herewith a map, showing the position and extent of the shoals in Kennebec river, near Shepard's Point, at Hallowell, Maine, with a plan and sections of the excavation for the proposed new channel through the shoals; showing, also, the direction and extent of the proposed dam for closing the present channel near Shepard's Point after the new channel shall have been opened, surveyed and drawn under my direction, in obedience to your instructions of the 3d of November last.

The soundings on this map are referred to the *lowest* water indicated by the lower tide-gauge during the time of the survey, which was on the 14th and 15th of November last. At the upper tide-gauge the water stood one and a half (1½) feet *higher* at *low* water than it did at the lower tide-gauge; whilst, at high water, it stood at the same height as it did at the lower gauge.

The proposed excavation, which is estimated from the lowest water indicated by the lower tide-gauge, will, therefore, in all cases be as great, and generally will exceed the amount actually required, when the water is not at a lower stage than it was during the survey. In the lowest stages of the river, however, it is probable that the water reaches a level from one to two feet lower than is indicated on the map, a fact only to be ascertained by actual observation during the "dry season." In which case, the estimate will have to be correspondingly increased.

The bed of the river is composed of sand, gravel, and pebbles. Borings were made in several places to a depth of a few feet below low water, near the line of the proposed channel, without finding any ledge or boulders of any considerable size.

The present channel of the river lies near its right (or west) bank, and makes a very abrupt bend around Shepard's Point, the maximum ebb current, at the time of the survey, being about three miles an hour.

Brevet Brigadier General Alexander, (my predecessor in charge of this work,) in his report, dated the 20th of September last, proposed a plan for improving this channel, which has received the approval of the department, to wit, "by dredging a new channel through Shepard's Point shoal; the dredging to be made with a view of obtaining a clear channel, *seven* feet deep at low water, with a width of sixty feet on the bottom, which would require a width at the top, in order to obtain the proper slopes, averaging about ninety feet."

The channel which the accompanying map shows to be most practicable to be excavated is, in my opinion, that indicated by the two parallel lines extending above and below Shepard's Point, from A to S, as it follows the general course of the river, and requires less excavation than any other location equally direct. It is proposed that the channel lying between the points marked M and S, through the shoal next below Shepard's Point, should first be opened, and the excavated material be deposited inside, or west of the line marked U V, leaving the present channel between Shepard's Point and U *open*, until the completion of the new channel between M and S; also that the material, afterwards excavated between the points A and L, be deposited, a portion of it immediately below Shepard's Point, inside or west of the line T U, so as to fill up the present channel and divert it into the new one, and at the same time give a uniform width to the river below Shepard's Point, and the remaining portion to be deposited above Shepard's Point, between the foot of the small island and the point W on the left bank below it.

The amount of excavation estimated for a channel, located as above described, and having a depth of seven feet below the *lowest* water observed during the survey, with a width of sixty feet on the bottom, and ninety feet on top, is 20,635 cubic yards, which, at 45 cents per cubic yard, would cost $9,285 75; and, adding ten per cent. for contingencies, $928 57, making the total $10,214 32.

This estimate includes the removal of the material, and depositing it in the required localities. But a channel of the same dimensions, at a stage of the water two feet lower than that indicated on the map, (and actual observations might show, though it is not probable that in the dryest season it reaches a still lower level,) would require an amount of excavation estimated at 35,360 cubic yards, which, at 45 cents per cubic yard, would cost $15,912; and, adding ten per cent. for contingencies, $1,591 20, would make total $17,503 20.

Colonel S. H. Long, late of the corps of topographical engineers, in his report dated September 20, 1837, recommended the excavation of a new channel through the shoals as above, but to be *eight* feet in depth at low water, with a width of one hundred feet on top. To make a channel of this depth, with a width of seventy-five feet on the bottom and 107 feet on top, which I too would recommend, would cost about fifty-four (54) per cent. more than for the above described dimensions.

About twenty years ago, ten years subsequent to the date of Colonel Long's report, the citizens of Augusta and thereabouts undertook to dredge out a channel above Shepard's Point, and they improved it in some localities. The accompanying map shows where some of the dredging was made between the points marked A and L, in the proposed channel through Hallowell shoals, immediately above Shepard's Point. The unfinished condition of the work, and the fact that the excavated material was not removed far enough from the channel, has caused it to be more or less filled up since that period.

In addition to the survey of the river at Hallowell, I have also had it surveyed above Hallowell as far as the bridge at Augusta, so as to include "Wyman's," "Britt's," and "Gage's" shoals, the maps of which, with estimates for the necessary excavation and cost of same, will soon be completed and submitted, and "the amount required for the *entire* completion" of the improvement between Shepard's Point and Augusta will then be reported.

The total amount already appropriated, therefore, (to wit, $20,000,) can be profitably expended upon the work during the next fiscal year.

In contracting for this work, my opinion, which differs from that of my predecessor, is, that it should be let out and paid for by the *cubic yard*, as the amount of excavation will depend upon the level of low water to be assumed as a plane of reference, which can only be ascertained by observations on the tides made in the lowest stage of the river, during the "dry season." These observations can be made while the work is in progress.

I have, therefore, before advertising for proposals, to respectfully ask to be instructed by the department which course I am to adopt in this matter—to let out the work by the *job*, as recommended by my predecessor, with an uncertainty as to the amount of excavation to be done, or by the *cubic yard*, to be measured from time to time, as the work progresses, the final depth and dimensions of the channel to depend on further examination of the river.

The following additional information, called for by the bureau circular dated the 22d of September last, in compliance with the act of Congress making the appropriation for this work, is furnished, viz:

1. The work is located in the collection district of Bath, Maine.

2. Bath, Maine, which is on the Kennebec river, about thirty miles below Hallowell, is the only port of entry in this collection district.

The ports of delivery are Phipsburg (in which Fort Popham, at the mouth of the Kennebec river, is located) and Georgetown, situated between Bath and the mouth of the Kennebec; also, Bowdoinham, Richmond, Gardiner, Pittston, Hallowell, and Augusta, above Bath, on the Kennebec, Topsham, on the Androscoggin, and Brunswick, on the Androscoggin and New Meadow rivers.

The United States arsenal is located at Augusta, Maine, on the left bank of the Kennebec, and Fort Popham is about twelve miles below Bath, at the mouth of the river.

Seguin and Pond island light-houses are near the mouth of this river.

3. The amount of *revenue* collected at this port of entry during the last fiscal year, as furnished by the collector, was $37,208 95.

4. The amount of commerce and navigation that would be benefited by the completion of the proposed river improvements is stated by the collector as follows:

"The whole tonnage of this district is something over 80,000 tons, all of which would be more or less benefited by the improvement of the navigation of the Kennebec.

"The works near the mouth of the river, such as Fort Popham, Seguin, and Pond island lights, are designed for the benefit of the whole district. The proposed improvement between Augusta and Shephard's Point, in Hallowell, would more particularly benefit vessels bound to and leaving those ports, and the completion of the work would doubtless cause great increase of business at those points. One steamboat has plied between Hallowell and Boston, and one between Gardiner and Boston, during the past season, carrying many passengers and much freight. These steamers would extend their trips to Augusta, if the contemplated improvement is made.

"The arrivals at Hallowell and Augusta, in 1865, were forty-two coastwise and five foreign vessels; at Gardiner, four miles below Shephard's Point, the arrivals were two hundred and twenty-three coastwise and ten foreign vessels."

Appended hereto is a copy of a letter bearing further upon this subject, from Hon. S. Caldwell, mayor of Augusta, Maine.

GEO. THOM,
Lt. Col. Corps of Engr's, Bvt. Col. U. S. A.

Brevet Major General A. A. HUMPHREYS,
Chief of Engineers, U. S. A., Washington, D. C.

MAYOR'S OFFICE,
Augusta, Me., December 28, 1866.

DEAR SIR: I have your favor, enclosing one from Colonel Thom, of the United States engineers, making inquiries in regard to the necessity and anticipated benefit of the improvement of the Kennebec river, between Shepard's Point and this city.

In reply I beg leave to state that for many years past all the interests of this vicinity depending upon cheap transportation have seriously felt the lack of steamer and sail-vessel communication with the outer world.

Steamers of large burden, and sailing vessels of very considerable tonnage, come within two miles of our wharves, and could they ascend higher, their numbers would be largely enhanced.

The business of this place is already, as you well know, very considerable, and, with the now certainly anticipated location of some very large manufactories upon our water-power, we can count upon a great increase of our business, thus rendering our lack of easy water communication more and more inconvenient.

The location of the United States arsenal at this place gives the government a more direct and immediate interest in the improvement than it would otherwise have. During the war, in the movement of ordnance stores to and from this place, the cost would have been greatly lessened, and the convenience to the government greatly promoted, could a sea-going steamer have come directly to the arsenal wharf.

If a depth of seven or eight feet at low water can be secured, I feel very sure that the commercial interests of this whole section of country would be greatly benefited.

* * * * * * *

Very respectfully, yours, &c.,

S. CALDWELL, *Mayor, &c.*

E. S. J. NEALLY, Esq.,
U. S. Collector, Bath.

R 8.

UNITED STATES ENGINEERS' OFFICE,
Portland, Maine, January 29, 1867.

GENERAL: I have the honor to transmit herewith two maps, (marked 1 and 2) showing the position and extent of the shoals in the Kennebec river, above Hallowell, Maine, and the location and sections of the excavations, for a proposed new channel, the survey and drawings of which have just been completed, under my direction, to enable me to furnish an estimate of the amount that is required for the entire completion of the improvement of the river between Shepard's Point and the city of Augusta, Maine, as contemplated by the law approved June 23, 1866, making appropriations for this work.

Sheet No. 1 shows that portion of the river extending from the bridge at Augusta down, to include Gage's shoal, and sheet No. 2 shows the river as far down as the bridge at Hallowell, including Britt's and Wyman's shoals.

Sheet No. 3, which was transmitted to you with my report dated the 21st instant, shows the river and shoals from the bridge at Hallowell down to include the shoal next below Shepard's Point.

The soundings shown on sheets Nos. 1 and 2, at Gage's and Britt's shoals, are referred to the lowest water observed at their respective tide-gauges in the month of December, whilst those soundings were being made, at which time the *low* water at Gage's and Britt's shoals was about two feet higher than the lowest water which was observed the month previous in the survey at Shepard's Point, indicated on sheet No. 3. It is probable, however, that in "dry seasons," when the river is at its *lowest* stage, the water falls about *two* feet still lower than was observed at Shepard's Point, or about *four* feet lower than is indicated by the soundings on sheets 1 and 2.

At Gage's shoal (the first below Augusta) the main channel of the river runs west of the shoal and near the right or west bank of the river. The shoalest water found in this channel, during its survey, was eight and one-half feet deep at low water, which would probably be reduced to four and one-half feet at the *lowest stages* of the river in the "dry season."

At Britt's shoal the shoalest water found in the main or west channel during the survey was seven and three-tenths feet deep, which, in the lowest stages of the river, would probably be reduced to three and three-tenths feet; whilst in the eastern channel, near the left bank, the shoalest water found during its survey was six and three-tenths feet deep, which, in the lowest stages of the river, would probably be reduced to two and three-tenths feet. These reduced depths, both at Gage's and Britt's shoals, agree very closely with those indicated on the map accompanying Colonel Long's report of 1837. Tidal observations, made at the several shoals during the "dry season," could alone give the exact corrections for reducing the soundings on the maps to the lowest stage of the river.

It having been decided by the department to give to the channel through the Hallowell and Shepard's Point shoals a depth of seven feet of water at low water, I would recommend that the channel to be excavated through the shoals above Hallowell (to wit, Britt's and Gage's shoals) should be seventy-five feet wide at the bottom, with sides having slopes of two feet to one foot rise, and have a depth of *six feet* in the lowest stages of the river, so that when the river is in that stage vessels drawing from nine to ten feet of water may, at high tide, ascend to Augusta.

The channel which I recommend to be opened through Gage's shoal is shown by the two parallel lines between the points A and G. This location coincides nearly with the present channel of the river. It is more direct, and it requires less excavation than any other location would require

At Britt's shoal there are two channels that are to be considered, to wit: the western channel, which lies between the shoal and the right bank of the river, and the eastern channel, which runs near the eastern bank. The eastern channel is more direct, and the estimated cost of its excavation is a little less than that for the western channel; but the nature of the river bed may, judging from its rocky shore, present greater obstacles to its excavation than the western channel, (a fact only to be ascertained by further examinations,) so that, to be on the safe side, I have adopted the estimate for improving the western channel.

At Wyman's shoal, immediately above Hallowell bridge, no excavation is necessary.

The bed of the river at Gage's and Britt's shoals is of the same character as at Shepard's Point shoals, being composed of sand, gravel, and pebbles, with occasional small boulders, and there does not appear to be any ledge or other obstacles to making the proposed excavations. This fact can easily be determined by borings, which I propose making.

The sections on sheets Nos. 1 and 2, showing the excavation required for the proposed channel through Gage's and Britt's shoals, give a depth of ten feet of water (at low tide) when the river is at the same stage as it was in December, at the time of the survey of those shoals; but a depth of eight feet only (at low tide) if reduced to the stage of the river as it was about the middle of November last, when the Hallowell and Shepard's Point shoals were being surveyed, and a depth of six feet only in the lowest stages of the river.

ESTIMATES.

I.—*Gage's shoal.*

For a channel having a depth of six feet at the lowest stages of the river, and seventy-five feet wide at the bottom:

8,870 cubic yards excavation, at 45 cents	$3,991 50
Adding ten per cent. for contingencies	399 15
Total	4,390 65

II.—*Britt's shoal, (western channel.)*

For channel of same depth and dimensions as above:

23,270 cubic yards of excavation, at 45 cents	$10,471 50
Adding ten per cent. for contingencies	1,047 15
Total	11,518 65

III.—*Britt's shoal, (eastern channel.)*

For channel of same depth and dimensions as above:

17,180 cubic yards of excavation, at 45 cents	$7,731 00
Adding ten per cent. for contingencies	773 10
Total	8,504 10

It is probable that a further examination of the river in its *lowest* stages would somewhat modify but not increase the above estimates.

For the *entire* completion of the improvement of the river between Shepard's Point and the city of Augusta, Maine, as contemplated by the law approved June 23, 1866, making an appropriation for this work, I have the honor to submit the following estimates, viz:

I. *Hallowell and Shepard's Point shoals.*—For a channel seven feet deep and sixty feet wide, as approved by the department, (see my report of 21st January, 1867)	$17,503 20
2. *Britt's shoal, (western channel.)*—For a channel six feet deep and seventy-five feet wide	11,518 65
3. *Gage's shoal.*—For a channel six feet deep and seventy-five feet wide	4,390 65
Total	33,412 50
Amount appropriated by the law approved June 23, 1866	20,000 00
	13,412 50
Additional amount required for the entire completion of the work, say	$15,000 00

I am, very respectfully, your obedient servant,

GEO. THOM,
Lieut. Col. Corps of Engineers, Brevet Colonel U. S. A.

Brevet Maj. Gen. A. A. HUMPHREYS,
Chief of Engineers U. S. A., Washington, D. C.

R 9.

Report of the survey of the "gut" opposite the city of Bath, Maine, by Brevet Brigadier General George Thom, lieutenant colonel corps of engineers.

UNITED STATES ENGINEERS' OFFICE,
Portland, Maine, September 10, 1867.

The act of Congress approved March 2, 1867, providing for the examination or survey of this locality, does not specify the object for which it is required.

This gut was surveyed by the United States Coast Survey in 1865, rendering any further survey of it at this time unnecessary. Accompanying this is a copy of the chart of the same, furnished by the Superintendent of the United States Coast Survey. In a personal examination of the gut or Upper Hell Gate, as it is generally called, I became satisfied that the object of the "examination or survey" called for was the improvement of its navigation.

Owing to the contraction of the channel of Back river at the Upper Hell Gate, which is about forty yards wide at low water, (caused by a ledge projecting out from the south shore,) the tidal currents run through this gate with such violence as to render its navigation exceedingly difficult and dangerous at any other time than at high and low water, except for steamers. The difficulties are still further increased by a large rock known as Boiler rock, which lies in mid-channel, about seventy-five yards below the gate, compelling vessels to make an abrupt change of course so as to pass south of the small island below.

This rock I carefully examined by the aid of a submarine party. It lies in from three to four fathoms of water, at low water, its upper or highest point being only about three feet below the surface at mean low water. It is an immense boulder, about thirty feet long and fifteen feet wide at the bottom, and twenty feet long by ten feet wide on its top. The tide here rises and falls from six to seven feet; so that at high water the rock has about ten feet of water upon it.

For the improvement of the navigation of this place I would respectfully recommend—

1. That the Boiler rock be removed to a depth of twelve feet at mean low water, requiring about 70 cubic yards of blasting, which, at $50 per cubic yard, would cost..................	$3,500 00
2. That the point of ledge contracting the channel at the Upper Hell Gate be blasted off so as to enlarge the water way, requiring about 1,500 cubic yards, at $4 per cubic yard..............	6,000 00
3. For deepening the bar about midway between the Upper Hell Gate and Arrowsic bridge, so as to afford a channel of 100 feet wide and 10 feet deep at mean low water, requiring 11,000 cubic yards of dredging, which, at 50 cents per cubic yard, would cost.	5,500 00
	15,000 00
Add 10 per cent. for contingencies...........................	1,500 00
	16,500 00

This amount, it is estimated, is sufficient for the entire and permanent completion of the proposed work; and it could all be profitably expended upon it during the next fiscal year. The following information is furnished, in compliance with the requirements of the act of Congress providing for this survey, viz:

The locality of the proposed improvement is in the collection district of Bath, Maine. Bath is the only port of entry in this collection district, and is distant from the Upper Hell Gate three miles. The nearest light-houses are Seguin and Pond Island light-houses, near the mouth of Kennebec river; and the nearest fort is Fort Popham, at the mouth of the Kennebec river, distant about fifteen miles.

The amount of revenue collected at the port of Bath during the fiscal year ending June 30, 1867, was $40,820 56.

The amount of commerce and navigation that would be benefited by the proposed improvement is shown by the letters hereto appended, marked A and B.

GEORGE THOM,
Lieut. Col. of Engineers, Brevet Brig. Gen. U. S. A.

A.

CUSTOM-HOUSE, BATH, MAINE,
Collector's Office, July 27, 1867.

DEAR SIR: I am at length able to answer the second interrogatory contained in your letter of the 15th instant, in relation to the proposed improvement of the gut opposite the city of Bath, Maine, viz: "What amount of commerce and navigation would be benefited by the proposed improvement?"

The answer is given in the statement transmitted herewith, prepared by Messrs. Sampson & Riggs, merchants, who reside at Georgetown, a short distance below the Lower Gate, and are largely engaged in fitting out and supplying fishing and other vessels and in general trade. Their means of knowing about what they affirm are ample, and their estimates are worthy of confidence.

This statement has been procured by Wm. H. McLellan, esq., of this city, the principal owner and agent of the steamer Spray, to whom I am much indebted for his endeavors to have it made as accurate as possible.

I am, very respectfully, your obedient servant,

E. S. J. NEALLEY, *Collector*.

General GEO. THOM,
United States Engineer's Office, Portland, Maine.

B.

Gut passage-way from Kennebec river to Sheepscot bay open nine months in the year; lower or Sheepscot bay end *never closed*.

Number of row and sail-boats passing per day from ten to one hundred; number of persons on board from three to twenty; value of boats from ten to five hundred dollars; value of property transported each trip fifty to four hundred dollars. Number of scows, or gondolas, average five per day; number of hands on board from three to four; value of property transported each trip from one hundred to fifteen hundred dollars. Number of smacks, from the size of sail-boat up to twenty-five tons, from ten to fifteen per day; value of craft from four hundred to two thousand dollars; number of hands to each from four to eight; value of property transported each trip from six hundred to thirty-five hundred dollars. Number of sailing and fishing vessels from twenty-five to eighty tons, four trips per day; value from one thousand to eight thousand dollars; value of cargo, fittings, and property on board each from eight hundred to three thousand dollars; number of hands to each vessel from four to twelve. Number of vessels from eighty to three hundred tons, one trip per day; value of vessels from eight to sixteen thousand dollars; value of cargo, nothing, mostly *all light;* number of hands on board from five to sixteen. One steamer, daily, (Sundays excepted,) up and back, valued at seven thousand dollars; number of hands on board three; average number of passengers twenty; value of freight each trip from one hundred to one thousand dollars. Some tug-boats, on the high-water rafts and tows of different kinds; logs in rafts to supply thirteen up and down saws in mills, say to the amount of forty thousand feet of lumber per month.

This short passage-way by tidal water from the Sheepscot bay to the Kennebec river, directly opposite the city of Bath, the whole length being from eight to nine miles, is, at the present time, and always has been, much used, though quite intricate from its many sunken rocks and quick runs. (Frontier Mission, Bartlet, chapter seventh, page 129; Ancient Dominions of Maine, pages 61, 62, and 63.)

By this passage we have access to some of the best tide-mill privileges in the United States. (Shattuck's Memorial, page 146.)

SAMPSON & RIGGS.

R 10.

Report on the examination of Union river, Maine, for the year ending June 30, 1867, *by Brevet Brigadier General George Thom, lieutenant colonel corps of engineers.*

U. S. ENGINEER OFFICE,
Portland, Maine, September 10, 1867.

An act of Congress, approved March 2, 1867, provides for the examination or survey of Union river, Maine, but the object of the survey is not stated in the law. On a careful examination of the river, however, I became satisfied that it was for the improvement of the *navigation* of the river from its mouth up to the head of navigation, at Ellsworth, a distance of about four and a half miles.

The channel of this river is in some places very much obstructed by "slabs," "edgings," and "sawdust," which have come down from the numerous saw-mills just above Ellsworth, and have become so completely interwoven as to have almost entirely closed the channel at low water near Ellsworth. These obstructions, together with numerous sunken rocks in the channel, and several rocky points projecting far out from the bank unmarked and unseen, except at low water, render the channel very intricate, and its navigation very difficult at all stages of the water.

Descending from the "upper landing" at Ellsworth, we find the river entirely filled at mean low water with "slabs," "edgings," and "sawdust," from three to four feet in depth, down to the "Sinker's wharf," one-third of a mile below "Nourse's Point;" nearly opposite to "Sinker's wharf" is a ledge covered with large boulders, extending from the right shore nearly half way across the river. It is entirely covered at high water, the rise and fall of the tide ranging from ten to fourteen feet. A stone beacon is here much wanted on its outer extremity at low water. The "Narrows," so called, commence about one-half mile below Ellsworth, (upper landing,) and extend for a distance of about half a mile downwards.

In the channel above the "Narrows" there are two or three boulders, each weighing from two to four tons, which can be seen at low water; these should be removed.

In the "Narrows" there are three boulders, and two more in mid-channel at the lower end, each weighing from one to four tons, all lying in two or three feet of water at low water; these should be removed.

Hall's Point (1½ mile below Ellsworth) is a ledge making out from the right shore and extending about one-third the way across the river. This ledge is bare at its outer extremity at mean low water, to mark which a beacon is necessary.

About 300 feet below Hall's Point a small boulder lies in the river, in about three feet of water at low water, and should be removed.

Sline Rocks are about two and a half miles below Ellsworth; they consist of two boulders, each weighing about two tons, lying in about three feet of water at low water; these rocks are very dangerous, and should be removed.

Fish Hole Point is about three miles below Ellsworth (upper) landing, and is a bold, rocky point, projecting about half way (say 300 feet) across the river, from its left bank, and then drops off suddenly into deep water; a beacon is much needed to mark its outer extremity at low water.

Fullerton Point, three and a half miles below Ellsworth (upper) landing, is a bold ledge making out from the left shore, and extending one-third the way across the river. Its outer extremity is about four or five feet above mean low water. This is a very important point to be attended to, as vessels are liable to strike on it at high stages of water; a beacon should be placed on its outer extremity.

Horton Rocks, opposite to Fullerton Point, are also bare two or three feet at low water, and should have a beacon to mark their outer extremity.

The lower bar, at the mouth of the river, about four and a half miles below Ellsworth, has about three feet of water on it at mean low water. This has been, it is said, somewhat increased of late years, by the accumulation of sawdust, which comes from the saw-mills above and near Ellsworth. Two boulders, bare at low water, lie in the channel, on this bar, and should be removed. At mean low water there are, except on the lower bar, about ten feet of water in the channel of the river from its mouth all the way up to near the foot of the Narrows; from the Narrows up to Ellsworth (upper) landing not more than four feet can be obtained.

The importance of this river as an outlet to the immense lumber trade and agricultural products of this section of the country is so great that the improvement of its navigation is most urgently recommended.

With a view to obtain a clear and unobstructed channel of not less than three feet in depth at mean low water, all the way up to the upper landing at Ellsworth, the following expenditures will be necessary, viz.:

1st. Removing 30,000 cubic yards of slabs, edgings, and sawdust, so as to give a channel of 150 feet wide from Sinker's wharf up to Ellsworth upper landing, at eighty cents	$24,000 00
2d. For removing thirteen boulders from the channel, at an average cost of $250	3,250 00
3d. For building five granite-cut stone beacons on the extremities of the ledges above named, the beacons to be eighty feet square and to rise about six feet above ordinary high-water mark, each containing about fifty cubic yards masonry, making in all 250 cubic yards, at $30 per cubic yard	7,500 00
Foundation for five beacons, at $300	1,500 00
Total	36,250 00
Adding ten per cent. for contingencies	3,625 00
	39,875 00

Say $40,000.

This amount, it is believed, would be sufficient for the entire completion of this work, and for its permanent completion, if the State laws which have recently been enacted for the protection of this river from further injury by the deposit of slabs, edgings, and sawdust, be properly enforced. As a further security, however, I would respectfully suggest that the attention of Congress be called to this matter, with a view to such legislation as may be necessary for the protection of the navigation of its navigable waters.

Should Congress see fit to appropriate the above sum (viz., $40,000) for the improvement of this river, which I strongly recommend, that amount can be profitably expended upon the work during the next fiscal year.

The following information is furnished in compliance with the requirements of the law providing for the examination of this river:

This river is in "Frenchman's Bay district." Ellsworth is the port of entry, being at the head of navigation of the river.

The nearest light-house is situated near the mouth of Union river, at Edgemoggin Reach. There is also one on "Bass Harbor Head."

The nearest fort is Fort Knox, in Penobscot river.

The collector of customs at Ellsworth is unable, for reasons given, to furnish a statement of the amount of *revenue* collected at that port during the past fiscal year. He states that there are about 20,000 tons of shipping owned in this district; there is manufactured on this river, annually, from 35,000,000 to 40,000,000 feet of lumber, nearly all of which is shipped from here. There is, of short lumber, of shingles, wood, &c., enough to make, say, 150 cargoes, annually, for vessels of about one hundred tons burden.

The yearly business on this river would give employment to say fifty vessels, running to Portland, Boston, New York, and intermediate places, these making from six to twelve voyages a season. The most of the lumber here is shipped to domestic ports, but the records of this office show that, for the quarter ending December 31, 1866, there were twelve American vessels which were cleared for foreign ports with lumber, the tonnage of which amounted to 3,983; value of cargoes, $49,800.

GEORGE THOM,
Lieut. Col. of Engineers, Brevet Brig. Gen. U. S. A.

R 11.

Report on the improvement of the navigation of St. Croix river, above the "ledge," by Brevet Brigadier General George Thom, lieutenant colonel of engineers, for the year ending June 30, 1867.

An examination of this river from the "ledge" up to the head of navigation, at Calais, Maine, a distance of about four miles, showed the object of the appropriation to have been specially the deepening of the channel by the removal of the "slabs," "edgings," and "saw-dust," which obstructed the navigation of the river between the points named.

The tide at this place rises and falls from twenty to twenty-five feet, so that at high water there are about thirty feet of water on the eastern or St. Stephen's side of the river, all the way up to the bridge which crosses from Calais, Maine, to St. Stephen's, in the province of New Brunswick.

At low water the channel is so much obstructed near Calais that vessels drawing four feet and a half can ascend only to the "lower wharf," also known as "McCollister's wharf," which is one mile and a half below the upper landing; while vessels drawing twelve feet can ascend, at low water, to a point about two miles above the "ledge."

From the upper landing down to McCollister's wharf the river is more or less filled with slabs, edgings, and saw-dust; while below McCollister's wharf, saw-dust, with very few if any edgings and slabs, have accumulated in the bed of the river.

These edgings, slabs, and saw-dust come from the numerous saw-mills on both banks of the river above and near Calais, and have been accumulating, I was informed, for thirty years and more. I was also informed that twenty-five years ago vessels of large draught, say fifteen feet, could ascend to Calais at low water.

While the causes of these obstructions to the navigation are still in operation, it would not appear advisable to expend the appropriation in removing them, until a sufficient protection is given to the channel by adequate State laws, or else by such laws of Congress as may be necessary to prevent obstructions or other injury to the channels of its navigable water. I would therefore respectfully recommend that the attention of Congress be asked to this matter, at as early a day as practicable.

By an act of Congress approved March 2, 1867, the sum of fifteen thousand dollars was appropriated for this work: "*Provided,* The province of New Brunswick shall contribute and pay to the proper disbursing officer a like sum for said purpose; said payment being made on condition that in no event shall the province of New Brunswick be called upon for more than half the sum actually expended for said purpose."

With a view to commencing operations in this river at as early a day as practicable, I applied to the department on the 26th of March last for information as to what understanding, if any, the province of New Brunswick had with the United States government in this matter. So far as I have been able to learn, that province has taken no action whatever in it, so that the matter will have to be brought to the attention of the new parliament, which is to convene in Ottawa, Canada, in September, for such legislation as may be necessary to give effect to the proviso of the law of Congress above referred to.

Operations in this river have, therefore, been necessarily suspended until the provisions of the law making the appropriation can be complied with.

For an accurate estimate of "the amount that is required for the entire and permanent completion" of this work, a careful survey will be necessary. The examination made by me showed that, to open a channel one hundred feet wide and ten feet deep at low water would require the removal of not less than 100,000 cubic yards of slabs, edgings, and saw-dust; which,

At 80 cents a yard, would amount to	$80, 000
Add 10 per cent. for contingencies	8, 000
Total	88, 000
Deducting one-half, if paid by the province of New Brunswick	$44, 000
Amount appropriated by act of Congress approved March 2, 1867	15, 000
Additional amount required	29, 000

Which amount could be profitably expended upon this work during the fiscal year ending June 30, 1869.

The following additional information is supplied in compliance with the requirements of the act of Congress approved March 2, 1867, having been furnished by the deputy collector at Calais, Maine, viz:

The contemplated improvements of the "St. Croix river, above the ledge," are within the collection district of Passamaquoddy, and near the custom-house in Calais.

There is no United States light-house now in use near this place, the nearest being in the vicinity of Eastport, Maine, about thirty miles below. There is no fort in the immediate vicinity, Fort Sullivan, also at Eastport, being the nearest.

The amount of duties collected at the custom-house in Calais, for the fiscal year ending June 30, 1867, was $18,500.

The amount of commerce and navigation that would be benefited by these improvements consists of about one thousand vessels, probably averaging about one hundred tons each, which arrive at this port annually, being principally engaged in the coasting trade.

Hereto is appended a statement by the deputy collector, showing the amounts of exports and imports at this port during the year ending January 1, 1867, the number of arrivals and departures, and the number of vessels built, marked A.

GEORGE THOM,
Lieut. Col. of Engineers, Brevet Brigadier General.

U. S. ENGINEER OFFICE,
Portland, Maine, September 10, 1867.

A.

PORT OF CALAIS.

Below we give the amount of exports and imports at this port during the year ending January 1, 1867, the number of arrivals and departures, and the number of vessels built:

Exports.—10,635,000 feet pine lumber; 17,394,000 feet hemlock lumber; 48,942,000 feet spruce lumber; 575,000 feet hard wood lumber; 210,000 feet hackmatack lumber; 100,000,000 lath; 4,000,000 pickets; 18,000,000 shingles;

35,000 ship knees; 14,000 cedar posts; 500,000 feet spool stuff; 400 cords birch wood; 370,000 hoops; 600,000 cedar sleepers; 53,000 clapboards; 200 cords bark; 139 ladders; 23,831 barrels calcined plaster; 8,065 casks ground plaster; 8,000 sides leather.

Imports—82,000 bushels corn; 24,000 barrels flour; 1,800 barrels pork; 174 barrels beef; 13,000 hides; 1,518 tons coal; 5,000 tons plaster.

Built in Calais.—2 barks, 2 brigs, and 4 schooners, 2,350 tons.

Arrivals.—976.

Clearances.—984.

B. M. FLINT, *Deputy Collector.*

APPENDIX S.

SAN FRANCISCO, *August* 5, 1867.

GENERAL: I have the honor to submit the following report of my official operations during the fiscal year ending July 30, 1867:

These operations have been conducted under the following appropriations, viz: survey of military defences; purchase and repair of instruments; removing obstructions to navigation in the Willamette river below Portland; and surveys and examinations on the Pacific coast. In addition to these, I am the engineer of the 12th and 13th light-house districts, and a member of the board of engineers for the Pacific coast.

The operations under the above mentioned appropriations will be described in the order named.

SURVEYS OF MILITARY DEFENCES.

Early in July, 1866, I started with an escort of ten soldiers, by order of General Halleck, commanding the division of the Pacific, from Fort Churchill, Nevada, to examine the country between there and Ruby City, Idaho, with a view of finding a more direct and practicable route for teams between those two points. The report of this reconnoissance was made to the general commanding the department of California, and, being local in its character, is not sent in with this report, though a copy can be furnished at any time if called for.

The notes of this reconnoissance, together with those taken on a similar trip during a portion of the preceding year, have been plotted, resulting in a map of that comparatively unknown region, concerning a section of country never before mapped with any degree of detail. A reduced copy of this map, scale twelve miles to the inch, has been prepared for publication in a cheap manner, and, by authority of the general commanding the department, has been lithographed and published, copies of which have been forwarded to the engineer department.

A map, on the same scale, of the whole of California, Nevada, Oregon, and a portion of Idaho, on one sheet, is nearly completed, and will be forwarded to the engineer department shortly, accompanied by a map of Arizona. These maps will represent, in much detail, all the known portions of those regions. Many portions are still unexplored, and, in consequence of the reduced number of troops in this department, the general is unwilling to spare troops for escort duty to topographical parties, and there seems but slight prospect of obtaining further topographical information with military assistance. One assistant has, by the suggestion of General McDowell, been for some months in Arizona, with instructions to accompany trains and scouting parties, and gather such topographical information as can be obtained in that way. Taking advantage of a geological party, directed by the geologist of this State, which is to travel through that portion of the State of Nevada near the 37th and 38th parallels, I have sent two other topographical assistants to accompany it. From this party very interesting results are expected, the country being nearly unknown.

My observations and investigations in meteorology and hypsometry have been prosecuted vigorously during the year. In February last I forwarded to you a report, complete in itself, of the results so far obtained, and believing they are of sufficient practical and scientific interest to warrant their publication, I have requested that they be published as a professional paper of the corps of engineers.

In the appendix to this paper are meteorological and hypsometrical tables, which, I think, will be considered superior to any heretofore prepared in English measures, and they contain all that an English or American meteorological computer may desire to take with him in the field on a reconnoissance.

The following is a statement of the amount received and expended during the last fiscal year on account of "surveys of military defences:"

On hand July 1, 1866	$4,153 34
Received during the year	12,000 00
Total amount received	16,153 34
Expended during the year	12,986 34
On hand July 1, 1867	3,167 00

PURCHASE AND REPAIRS OF INSTRUMENTS.

The amount expended for repairs is large, as some of the repairs were made during the two previous years:

On hand July 1, 1866	$000 00
Received during the year	2,500 00
Expended during the year	703 58
On hand July 1, 1867	1,796 42

REMOVING OBSTRUCTIONS TO WILLAMETTE RIVER.

The order dated Washington, July 21, 1866, placing me in charge of this work, was not received until about the middle of October, in consequence of my being absent in the field on a reconnoissance.

From all the information I could collect, shortly after its receipt, I found it would be impracticable to do any work on that river during the seasons of winter and spring. I sent, however, my assistant, Lieutenant Heuer, United States engineers, to make an examination of the river, the report of which has shown you that the information before received was correct.

The city of Portland had, during the two previous years, done work on this river by dredging, with the view of deepening the channel of the river, and had provided suitable dredging and other apparatus. Therefore the city authorities is the only party who can with economy do the work.

After making one bid for removing Swan Island bar, at a price exceeding the amount of the appropriation then available, the city have offered me the use of all the machinery free of cost, if I will keep it in repair and use it.

The act of Congress requires that the work be done by contract if possible. I was, therefore, directed to again invite proposals in the newspapers; and no bidders presenting themselves at the expiration of the time specified for opening the bids, I have accepted the offer made me by the city, and will commence work by hired labor in August next, which is the earliest possible time when dredging can be done.

I am directed to report on the following ten points, which I now do to the best of my ability:

First. No survey or resurvey has been made by me, as, since I have been placed in charge of the work, the water has been too high to admit of work. The city, however, had made a survey of Swan Island bar, showing that

48,000 cubic yards of earth would have to be taken out to deepen the channel to eighteen feet of water. No such survey at the mouth of the river, where there is also a bar, has been made..

Second. The data to ascertain the amount required for the entire completion of the work is not at hand, as no actual work has been done by me for the above reason; but from the best information in my possession, based on rough estimates of work done and to be done, the sum of $25,000 will be required for the completion of the work, in addition to that on hand.

Third. The sum of $25,000 can profitably be expended during the next fiscal year.

Fourth. The nearest collection district is Astoria.

Fifth. The nearest town is Portland.

Sixth. The amount of revenue collected is unknown to me.

Seventh. The amount of commerce and navigation to be benefited by the completion of the work is large. Steamers drawing fifteen feet of water run from San Francisco to Portland regularly three times a month, except when stopped by extreme low water at the bars to be removed.

Eighth. Proposals were invited, but no bidders appeared; hence the work must and will be done by hired labor.

Ninth and tenth. Hence no contracts were made.

The following are the amounts received and expended during the last fiscal year on account of the appropriation for removing obstructions to navigation in the Willamette river, below Portland:

On hand July 1, 1866	$000 00
Received during the year	10,000 00
Expended during the year	871 49
On hand July 1, 1867	9,122 51

SURVEYS AND EXAMINATIONS ON THE PACIFIC COAST.

The order for this work was dated at the same time with the one just described, and for the same reason the order was not received until in October, 1866. Additional appropriation was made March 3, 1867.

The works designed to be executed under these appropriations are—

Survey of Blossom and Rincon Rocks, in the harbor of San Francisco, with the view of their ultimate removal.

Survey of the upper Columbia river, Oregon.

Survey of Crescent City harbor, with the view of making it a harbor of refuge.

Experiments had previously been made on Rincon Rock, and as accurate surveys of both rocks had been made by the Coast Survey, it was deemed only necessary to make experiments on Blossom Rock to obtain data for estimating the cost of its removal. This has been done, and the results fully explained in the report of Lieutenant Heuer, who had immediate supervision of the work. The report was dated March 28, 1867, and forwarded by me to the engineer department the next day. From this report it appears that the probable cost of removing the rock will be $60,000. The amount expended on the experiments was $3,148 52, and the amount of stone removed 69 cubic yards. The amount of expenditure would have been much greater but for the kind assistance of the Coast Survey in furnishing a vessel, officers, and crew.

On the upper Columbia no actual work has been done, for reasons similar to those explained when speaking of the Willamette river.

An examination of this river has been made by Lieutenant Heuer during low water, and by myself during high water, showing that no work can be done until August. All preparations have been made to prosecute the work with vigor after its commencement.

The paper appended to this report, and marked A, is a report of the president of the Oregon Steam Navigation Company upon the commerce and navigation of the upper Columbia, and affords the fullest information on the subject.

A survey of Crescent City harbor has not been commenced by me, as I have been furnished from the Coast Survey office at this place a tracing of a chart of the harbor, sufficiently in detail to determine, after personal examination both by Lieutenant Heuer and myself, the position and extent of the proposed breakwater, and a rough estimate of its cost. This estimate, indefinite as it may be considered, would not be more exact if months were spent in another survey. The amount of stone required is sufficiently well known; the cost of putting it in position is what is indefinite. To build the breakwater will require about 410,000 cubic yards of stone. The same amount of materials thrown in the sea to build the breakwater at Plymouth cost $7,000,000, as was fully explained in my report to the engineer department, of July 29, 1867. This, with the report of Lieutenant Heuer, of July 20, afford full information on the subject. For reasons given in my report, no appropriation is recommended for Crescent City harbor.

I will now endeavor to report on the following ten points referred to in the act of Congress, viz:

1st. No survey or re survey has been made other than the one of Blossom Rock, since I have been placed in charge of this work, on account of high water.

2d. The data on which to determine the actual amount required for the completion of the survey of the upper Columbia is not at hand, as no actual work has been done, but from an examination of the river I think the amount on hand is enough to complete the survey, and that the sum of $50,000 should be appropriated for work during the next fiscal year, in actually removing the obstructions.

For the removal of Blossom Rock, $60,000 has been recommended. I do not recommend an appropriation for the removal of Rincon Rock until Blossom Rock has been removed. No appropriation for improving Crescent City harbor is recommended.

3d. The amount that can be profitably expended next year on the upper Columbia is	$50,000
For Blossom Rock	60,000
Total	110,000

4th and 5th. The collection district for the work at Blossom Rock is San Francisco; and for the upper Columbia, Astoria.

6th. I have no means of ascertaining the amount of revenue collected at the nearest port of entry.

7th. The amount of commerce and navigation at San Francisco and on the upper Columbia is large. In 1864 there were 36,000 passengers and 21,834 tons of freight on the upper Columbia, and it is believed the amount has greatly increased since.

8th, 9th, and 10th. No work done by contract.

The following is the amount received and expended during the last fiscal year on account of the appropriation for "surveys and examinations on the Pacific coast:"

On hand July 1, 1866	$0 00
Received during the year	10,445 75
Expended during the year, Blossom Rock	3,148 52
" " " Upper Columbia	661 42
On hand July 1, 1867	6,635 81

My duties as a member of the board of engineers for the Pacific coast have occupied a small portion of my time.

No light-houses have been erected during the year, except one at Cape Gregory, Oregon, together with the keeper's dwelling. The light is now in working order. Several light-houses have required and received repairs.

I have the honor to be, very respectfully, your obedient servant,

R. S. WILLIAMSON,
Brevet Lieut. Col. U. S. A., Major of Engineers.

Major General A. A. HUMPHREYS,
Chief of Engineers U. S. Army.

OFFICE OF OREGON STEAM NAVIGATION COMPANY,
Portland, Oregon, July 20, 1867.

SIR: Yours of June 17 proximo, giving extract from an act of Congress making appropriations for examination and survey of certain works of improvement, and asking for information concerning the various lines of river transportation on the upper Columbia, of the obstacles to such transportation, &c., duly received.

In reply, I shall as briefly as possible touch upon the points named, and give you such information as you desire, so far as I am able to do so.

What is known as the upper Columbia river is that section between Celilo, or the main Dalles of the Columbia, to Priest's rapids, a distance of two hundred miles, and is navigable with light-draught steamers at all seasons when not obstructed by ice. At present there are six stern-wheel steamers employed on this section of the river, three of which are large-sized boats, with carrying capacity of from two to three hundred tons each, and are used during the season of high water, say from the 1st of May to the 1st of September. The other three are small light-draught boats, with carrying capacity of from seventy-five to one hundred tons each.

From 1st of May to 1st of September, Snake river, from its mouth to Lewiston, a distance of one hundred and seventy miles, is added to the navigation of the upper Columbia.

From Celilo to Priest's rapids the navigation is obstructed during the season of low water, by the following-named rapids, viz: "Five Mile rapids," "John Day's," "Indian rapids," "Squally Hook," "Rock creek," "Canoe Encampment," "Devil's Bend," "Umatilla rapids," and "Homely rapids."

The rapids presenting the most serious obstacles to navigation are "John Day's," "Umatilla rapids," and "Homely rapids," but all require more or less improvement to admit the use of large boats during the season of low water.

I shall not attempt to describe the character of these obstructions, or give an opinion as to the amount of work or means necessary to remove them. Lieutenant Heuer has examined, and has doubtless reported on this point all that is necessary for your information.

I would add, however, that "Homely rapids" is situated just below the mouth of Snake river. The Columbia at this place is broad and full of bars. Channel obstructed with narrow ledges or boulders, which, if removed, would enable boats at low water to reach "Priest's rapids;" and as Snake river rises much sooner in the spring than the Columbia, the removal of this obstruction would enable boats to reach Lewiston at least three weeks earlier than at present.

From Celilo to "Priest's rapids," and from the mouth of Snake river to Lewiston, the banks of the river and the adjacent country are entirely destitute of timber; hence the article of fuel must either be carried in large quantities for so long a trip, or transported by steam or sail at great expense to convenient points along the river, for the accommodation of steamers, and more particularly for the smaller class, which if compelled to carry wood for the round trip, would have little or no capacity for freight.

Tributary to this section of the Columbia river is a large mining country bordering on the Columbia river, north of the forty-ninth parallel. An American steamboat has been successfully navigating the Columbia, from what is known as "Little Dalles," near Fort Colville, to "Death rapids," about two hundred and fifty miles north of the boundary line between the United States and British Columbia.

The Hudson Bay Company, who do a large business in that section of the country, and who, before this boat was built, supplied their posts from Victoria via Frazer's river, now ship all their supplies via Columbia river.

Colville valley (in which Fort Colville is situated) is rich in agricultural and mineral wealth, and is rapidly filling up with permanent settlers. It can only be supplied via Columbia river. It is distant from Wallula about one hundred and seventy-five miles, and almost due north. There are now three steamboats navigating Clark's fork of the Columbia, from foot of Pend d'Oreille lake to Thompson falls.

The inducement offered to shippers by the establishment of this line has been such as to make tributary to the Columbia river all that rich mining country lying west and north of Helena in Montana Territory. The distance necessary to connect the boats of the upper Columbia with the boats of Pend d'Oreille lake is one hundred and sixty miles, over a good wagon road.

It is the intention of the parties engaged in the enterprise to place a fourth boat on Clark's fork, to connect with the others, from Thompson's falls to the mouth of Jako, making the whole distance by steam on Clark's fork two hundred miles.

It is said that the mouth of Jako is only one hundred and twenty miles from Fort Benton on the Missouri river, and if so, the navigable waters of the Missouri and Columbia rivers are only separated by two hundred and eighty miles of land travel.

Already a large amount of freight consigned to different points in Montana has been and is being shipped up the Columbia. This trade is rapidly increasing, and must at no distant day be a large item in the business of the river. In short, all the country east of the Cascade range of mountains, from latitude 42° to 52° north, including all of eastern Oregon and Washington, all of Idaho, and a large portion of Montana, must of necessity be tributary to the Columbia river.

The following figures will show the increase of business on the Columbia river from 1861 to 1864, inclusive:

	Number of passengers.	Tons of freight.
1861	10, 500	6, 290
1862	24, 500	14, 550
1863	22, 000	17, 646
1864	36, 000	21, 834

I have not the figures before me to show the continued increase to the present time, but to show how rapidly the country is filling up with permanent settlers, I will state that previous to the present year, all the flour and most of the grain necessary for the supply of military posts in the department situated east of the Cascades was shipped from Fort Vancouver up the Columbia river to convenient points, and thence by teams at great expense to the different posts. This year the valleys of Colville, Walla-Walla, Grand Ronde, and Powder river, have produced a large surplus of all kinds of grain, the result of which is, that the government is now supplied at much less rates than was previously paid for transportation alone.

Two years ago, all the flour necessary for the supply of a large mining population in Idaho and eastern Oregon was shipped up *the Columbia river.*

In June of this year Walla-Walla valley alone shipped down the Columbia, for San Francisco and New York markets, *over five hundred tons of flour*, and has remaining for shipment at this date at least twenty thousand barrels.

Cheap freight is of the first importance to an agricultural country. To secure this to the valleys tributary to the upper Columbia, it is absolutely necessary that the navigation be so improved as to make it practicable for the use of the largest class boats at all stages of water.

Average high water on the upper Columbia, from 1st of May to 1st of September; medium stage, from September to middle of November; low water, from November to middle of March.

River obstructed by ice from thirty to sixty days of each year. Last winter there was no ice to interrupt navigation.

I have the honor to be, very respectfully, &c.,

J. C. AINSWORTH,
President O. S. N. Company.

R. S. WILLIAMSON,
Brevet Lieut. Col. U. S. A., Major of Engineers.

S 1.

SAN FRANCISCO, *January* 28, 1867.

GENERAL: I have the honor to acknowledge the receipt of your letter of December 29, 1866, concerning the operations on the Willamette and Columbia rivers.

In obedience to your instructions, I shall invite proposals for the removal of the obstructions at Swan Island bar, by advertising said proposals in newspapers in this city and in Portland, Oregon, according to regulations. The bids will be sent on to Washington for approval.

Your directions also state that I am to ascertain the amount of rock to be removed in the upper Columbia, with sufficient accuracy to admit of a reliable estimate of the quantity to be blasted, &c. With that view a survey of the rapids of the upper Columbia will be made; but such work cannot be commenced to advantage, according to the best information I have collected, until the 1st of August next, and that information convinces me that that is the proper time to commence such work. I have corresponded with Captain Ainsworth, the president of the Oregon Steam Navigation Company, on this subject, with regard to the most economical and satisfactory manner of making this survey, and have suggested three plans of operation, one of which must be adopted. I will premise by saying that Captain Ainsworth owns or controls all the steamboats and nearly all the sailing vessels on the waters above the Dalles. I inquired if a small steamboat could be chartered for the surveying party, and in reply was informed it would cost $4,000 in gold per month. This was for steamboat and crew, but exclusive of the pay and subsistence of the engineer party. This I considered out of the question. I have to resort to one of the other two modes of making the survey, viz: one by chartering a sailing vessel, which can be had at a much less price; but whether one can be had of sufficient size to admit of the party living and messing on board of her is a question to be still decided. The other plan is for the party to live in tents on shore, and be provided with boats, and move from point to point by aid of the passing steamers. In either case the operation will be expensive, on account of the thinly settled country, and no definite estimate can be had of the expenses until determined by experience. The obstructions being mostly needle rocks, their size is to be determined by accurate surveys. The expenses of removing them will be best learned after the experiments on Blossom Rock, now to be commenced this week.

The part of your instructions most difficult to carry out is that relating to the mouth of the Willamette, and, fortunately, there is time to receive further instructions and explanations from you, as I cannot conceive it possible to prosecute to advantage such work as is directed in your instructions for the next two months. We have here, so far, a very severe winter, as the California newspapers will show you. (A strip from yesterday's Bulletin is enclosed.)

You state that "the conditions existing at the mouth of the Willamette should be studied with care, and observations upon the direction and force of the currents in the various channels should be made at those stages of that and the Columbia river which are believed to control the formation of shoals and the channels over them." It is supposed that the formation of shoals depends in a great measure on the *relative* force of the currents in the two rivers. At one time the one river may be high and the other low, and at another the reverse may be the case. They differ in different years, according to the varying amount of rain in the Willamette and snow in the upper Columbia.

Hence, to study fully the problem of the removal of the obstructions at the mouth of the Willamette, observations should be made at all seasons of the year and for several years. Meteorological records show that in one year the amount of rain may be four times as great as in another year. To obtain such observations as are described in the report on the Mississippi would require a party in constant employment and of considerable strength, and would probably entail an expense of $1,000 in gold per month.

I did not understand that any portion of the appropriation for "removing obstructions" was intended to be applied to the study of the character of the rivers. The appropriation for these removes was inadequate for their removal, but much work by private parties had been done. A plan of operations had been adopted by those parties, and the very parties who had commenced the work (who, I am told, were the city authorities of Portland) had exerted themselves to procure the appropriation. The question then was, shall those parties, who have already expended more than the amount of the appropriation, continue the work by the aid of this appropriation, (which they could do much more cheaply, as they had the boats, &c., at hand,) or should the government act in an independent way and commence the work anew? Under these circumstances, and with the facts already given, I think it best to ask for more definite instructions as to how to prosecute the work at the mouth of the Willamette, particularly as all the work has been suspended in consequence of the season.

I will recall, in brief, the plan of operations they proposed, which is, inasmuch as the present ship channel is in quicksand, and when dredged out is soon filled up again, and whereas the south channel, which is said to have a hard bed, is believed to afford a chance for a permanent channel, when once made of the proper depth, it is proposed to make it *the* ship channel by dredging. Shall we expend the part of the appropriation available in this experiment, or shall we expend it in studying the character of the river?

I submit an estimate of the cost of removing the obstruction in the Willamette river, made by Lieutenant Heuer, which is to be accepted as a rude one.

I have the honor to be, very respectfully, your obedient servant,

R. S. WILLIAMSON,
Brevet Lieut. Colonel U. S. Army, Major of Engineers.

Major General A. A. HUMPHREYS,
Chief of Engineers, United States Army.

[Extract from San Francisco Bulletin.]

THE WEATHER.—The great question now being asked is, "When will it stop raining?" We have had an almost steady flow of rain for a mouth, and the chances of its drying up are apparently as slim as they were at the commencement of the deluge. According to Tennent's rain gauge .17 of an inch fell on the 22d instant, .40 on the 23d, .35 on the 24th, and .14 up to 8 o'clock this morning. The rain fall thus far is about 21 inches, and still it comes. Cold weather, too, accompanies the rain, and the hills in Contra Costa county were yesterday white with snow. To-day it is raining as hard as ever, and unless nature's reservoir becomes exhausted visions of dire calamities by flood will disturb the public mind.

S 2.

SAN FRANCISCO, CAL., *April* 17, 1867.

GENERAL: I have the honor to acknowledge the receipt this day of your letter of March 8, 1867, concerning the Willamette river. The statements made in the report of Lieutenant Heuer of November 27, 1866, were considered reliable, as he visited the mouth of the river and consulted with all the parties interested, particularly consulting with the engineer employed by the city, on whose judgment every one there seemed to rely.

I have received also this day the enclosed letter from Mr. McCraken, chairman of the committee of the board of supervision on river improvement, in which is explained the discrepancy in the estimate made from the information gained from the civil engineer and the actual work to be still done on Swan Island bar. I think it probable that there was no reliable estimate made of the work done on that bar. The dredger would be used on it for a few days and then removed to another locality at the mouth of the river, where it was thought work would be most required, and no separate estimates were made.

I have every reason to suppose that the city authorities are sincere in stating that they did not expect the appropriation to cover the cost of the work, and I think that by accepting the proposition made the money will be judiciously spent.

If you concur with me in this view, I would respectfully suggest that you telegraph to me to that effect, as it seems some work can be done on the river before the freshets commence.

As the board of engineers think of visiting San Diego soon, to return about the 10th of May, I will be at leisure, and will, as soon as possible after an answer to this is received, visit Portland and the Willamette, and will conclude such arrangements as you may direct.

Very respectfully, your obedient servant,

R. S. WILLIAMSON,
Brevet Lieut. Col. U. S. A., Major of Engineers.

Major General A. A. HUMPHREYS,
Chief of Engineers U. S. A., Washington, D. C.

CALIFORNIA, HAWAIIAN, AND OREGON PACKET LINES,
Portland, April 13, 1867.

DEAR SIR: Your valued favor came to hand and was placed before our board. We can explain the discrepancy readily by a plat or sketch of the river as surveyed by a competent engineer, which will show 46,000 cubic yards to be excavated to give the required depth. Our former engineer was too sanguine, (an excellent man to conduct the mechanical part of the work,) and thought, at least represented, that he had done more and there was really less to do than the facts prove.

Another error of his: he gave the cost per month of running the dredge at $1,000 in coin, when he omitted in that estimate $25 per day, (Sundays included,) or $750 per month, for a steam tow-boat.

The city did not expect the appropriation to cover the cost of the work, but endeavored to avail itself of the amount to go as far as it would and pay the balance out of its treasury.

I think I am warranted in assuring you that if the general government will undertake the work itself, and prosecute it vigorously, (as you are aware time is important to its interest,) the dredge will be placed at its disposal, to be returned in as good order, excepting ordinary wear and tear. But we will send the sketch when a copy is taken and write more fully on this subject by the next mail.

Thanking you for your kind interest in this matter, I remain, yours, truly,

JOHN McCRAKEN.

Colonel R. S. WILLIAMSON,
Engineer U. S. Army, San Francisco.

SAN FRANCISCO, *May* 30, 1867.

GENERAL: I have the honor to enclose herewith a copy of the advertisement which appeared for the first time in a morning paper here, as authorized by your letter of April 26. A similar advertisement will be sent to the Portland Herald.

Last evening I received a letter from the mayor of Portland, enclosing a resolution of the common council of that city, which is enclosed. The letter states that all facts relative to the nature and condition of the bars of the Willamette will be furnished me in a short time.

I have the honor to be, very respectfully, your obedient servant,

R. S. WILLIAMSON,
Brevet Lieut. Col. U. S. Army, Major of Engineers.

General A. A. HUMPHREYS,
Chief of Engineers, U. S. Army.

Sealed proposals in duplicate will be received by the undersigned at his office in Portland, Oregon, until noon of Thursday, the 27th of June, 1867, (when they will be opened, and bidders are invited to be present,) for deepening the Willamette river, between Portland and its mouth, to admit the passage of vessels drawing eighteen feet of water, by dredging over or through Swan Island bar, and the bar at the western mouth of the river, (the one between J. D. Percy's island and Laurie's island,) the channel of said depth to be at least 100 feet wide at the bottom.

Bidders will state their proposals in the government currency of the United States, and payment will be made on the satisfactory completion of the work, after examination by the undersigned or other authorized agent of the government, who will be on the spot at the time for the purpose. The payment is to be made in such funds as are furnished by the government.

Each bidder will be required, before the time fixed for the opening of the bids, to file in the office of the undersigned a bond with sufficient sureties, in a penalty of five thousand (5,000) dollars, conditioned that if his bid is accepted, he will execute a written agreement for the faithful performance of his contract, and give such further bond for the performance of his written agreement as may be required; and said agreement is made subject to the approval of the Chief of Engineers United States army.

The contract will be awarded to the lowest responsible bidder, but the right to reject any and all of the bids is reserved.

A copy of this advertisement must be attached to each bid.

Bids that do not comply with the above requirements will not be entertained.

The expense of the advertisements must be paid by the successful bidder.

R. S. WILLIAMSON,
Brevet Lieut. Col. U. S. Army, Major of Engineers.

Be it resolved by the common council of the city of Portland, That the honorable the mayor be, and he is hereby, authorized and instructed to correspond with Colonel R. S. Williamson, United States engineer, and fully inform him of all particulars and facts at hand relative to the nature and condition of the bars of the Willamette river, both at Swan island and the mouth of said river, the amount of and cost of the work that has been done by the city, and the urgent necessity of prosecuting it at an early day.

And further, that the mayor be empowered to tender to Colonel Williamson (in the event he shall proceed to expend the appropriations made by the United States government for the purposes intended) the use of the dredging apparatus belonging to the city free of charge, provided he shall keep the same in thorough repair; and that he be further instructed to withdraw the proposal for dredging Swan Island bar, made under resolution of the common council passed March 8, 1867. Passed the common council May 16, 1867.

W. S. CALDWELL, *Auditor and Clerk.*

S 3.

SAN FRANCISCO, *July* 29, 1867.

GENERAL: I have the honor to report that on my return from the northern coast, (where I had been on light-house duty and had visited, among other places, Crescent City,) I found your letter of April 26, directing me to take charge of the survey of Crescent City harbor; and I submit a plan for its improvement, with a view of making it a harbor of refuge. My first step was to ascertain what had already been done towards a survey of that harbor, and on application at the Coast Survey office in this city I was kindly furnished with a copy of a Coast Survey chart of it—scale, 1-10,000—which is enclosed with this report. On its examination it appeared to me that it contains information sufficiently in detail to enable me to devise a plan for this improvement as well as if a more elaborate survey were made, which would require months of time and a considerable expenditure. It was necessary, however, that I should obtain some detail information on certain points, and as duty with the board of engineers for the Pacific coast, together with the operations on the Willamette and Columbia rivers, made it important that I should go at once to Oregon, I directed Lieutenant W. H. Heuer, United States engineers, to proceed to Crescent City for the purpose of obtaining the necessary information. He was instructed to examine the locality; ascertain the nature of the material to be found there; whether stone of great size and weight can be obtained; the means of transportation for them to the proposed place of deposit; whether a right of way for a railroad can be had from the place where the stone is found to the water near the place of deposit; the facilities in the vicinity for machinery and labor; the effects of previous storms on the harbor, and all other information that would enable him to make a comprehensive report on the subject, with drawings and sections of the proposed work. His report is enclosed, and his estimate exceeds two millions of dollars, ($2,000,000.)

It is almost impossible to make anything like an accurate estimate of the cost of such a work, but by comparing the cost of other breakwaters which have been actually constructed or estimated for, some light may be thrown upon the subject, though it is very true that in each particular case elements come into the calculations which naturally affect the estimate. The case of the breakwater at Plymouth, in England, may be considered one not very dissimilar, and therefore I will state some of the facts concerning it. That work is 1,700 yards long, 210 feet broad at its base, and 30 feet at the top, which is 10 feet above ordinary low water of spring-tide. The amount of stone thrown in during the five years ending 1816 was one million tons, and the work was then considered about one half completed. The amount actually expended during that five years was £1,524,000, equal to $7,563,173, and the estimate for the completion of the work was £1,562,639, equal to $7,563,173. To compare the magnitude of that work with the one proposed at Crescent City we may consider that the amount of stone required, according to the estimate of Lieutenant Heuer, is 409,914 cubic yards, which, if it weighs 170 pounds to the cubic foot, will weigh 940,753 tons, or nearly the quantity thrown in during the first five years at Plymouth. At the same rate of cost as at the Plymouth breakwater the one proposed for Crescent City will cost $7,000,000. The cost of labor, &c., in England when that work was prosecuted and their cost at this time in California is very different. I have no data with which to base an accurate estimate or comparison, but I think that it is certain we may reasonably increase the estimate several fold. The work just spoken of and others in England and France have been constructed by throwing huge masses of stone into the sea at random, *(pierre perdue.)* The size of the stones used varies from one to five tons and upwards. The heaviest masses are required between the levels of low and high water, but their size must of course vary with the peculiarities of the localities; for in a place not subject to violent storms, as in sheltered bays, the stone may be comparatively small. They must, however, always be of sufficient size and weight not to be moved by the action of the waves. This is absolutely necessary to secure stability. We have every reason to suppose that at Crescent City none but the largest masses ought to be used, the violence of the winter storms there being very great. It is therefore doubtful if it will be practicable to procure stones of sufficient weight. This was found to be the case with the breakwater at Algiers, where the sea carried away nearly all the stones that were thrown in, though the blocks used were from 100 to 141 cubic feet, (eight to twelve tons.) To preserve the work care was constantly taken to replace them. When that place fell into the hands of the French a different system was adopted, viz., that of using huge masses of beton instead of natural stone, and of such size as to resist the action of the sea and remain inmovable. The minimum limit to the size of those blocks was 353 cubic feet. An interesting account of this work is to be found in the rudimentary treatise on foundations in Weale's series, by C. E. Dobson. That breakwater was completed in 1835, and, according to that writer, "gave it a stability which is proof against the severest test." Nevertheless, I find in the "papers relating to the report of the British harbor of refuge commission, 1846," the following: "The last fact to be noticed respecting the work at Cherbourg constitutes a very decided warning against the use of concrete, for the application of this material on a large scale has utterly failed, the blocks of concrete being broken to pieces." The "concrete" here spoken of may not have been made with hydraulic lime. We have every reason to suppose that large masses of artificial stone of a sufficiently durable character can be made. In the plan here submitted for a breakwater at Crescent City the width of it is to be 30 feet, like the one at Plymouth. At a very exposed place, like Crescent City, a much greater width may be necessary. The jettee at Algiers had a top width of 118 feet. It would scarcely be worth while going into the examination of other works of this kind. We must come to the general conclusion that any breakwater at Crescent City must be a work of immense magnitude; that it is impossible to make any but a very rude approximate as to the cost of its construction, but that at least $2,000,000 would be required for it—and it may require several times that amount. The argument in favor of a work of this kind at that place is, that it is the only place between San Francisco and Cape Flattery where a harbor of refuge can be made, and hence one should be made there. There is no great city there and no populous back country. Crescent City has but one hundred or two hundred inhabitants, if it has as many. All to the rear is a sparsely settled country or dense forest. The immense expenditure required for the construction of a breakwater at that place would be but the beginning of a large series. If a harbor were made there immense sums would be required for its fortifications, for otherwise it would be of valuable assistance to an enemy. Probably, also, constant work would be required in dredging to prevent its being filled up. With all these facts in view, I do not recommend an appropriation for the commencement of a breakwater at Crescent City at present.

I have the honor to be, very respectfully, your obedient servant,

R. S. WILLIAMSON,
Brevet Lieutenant Colonel U. S. A., Major of Engineers.

General A. A. HUMPHREYS,
Chief of Engineers U. S. A.

SAN FRANCISCO, CALIFORNIA, *July* 20, 1867.

SIR: I have the honor to report, that I proceeded to Crescent City, California, and examined the vicinity with a view of obtaining information which would enable me to make plans and estimates for a breakwater to be constructed there. During the summer months the prevailing winds there are from the northwest; against such winds Crescent City harbor is now a comparatively good one, the only objection thereto being a few dangerous sunken rocks; but during the winter, when the winds are from the southwest or from the southeast, vessels can with the greatest difficulty lie there. Captains in command of vessels running up and down the coast inform me that a heavier swell occurs there (Crescent City) than anywhere else on the whole coast. During the winter months large logs, some of them twelve feet in diameter, are thrown violently on the beach by this swell, and several houses, against which these logs have been thus thrown, were battered down. Several years ago a wharf was constructed there on piles running from the main shore, near Battery Point, to Flat Rock, but some large drift-logs coming in contact with it during a gale, it was utterly demolished. Battery Point is the proper place from which to start the breakwater, although at first sight the southeast side of Light-house island appears the most eligible, but during gales the sea is forced in between this island and Battery Point with such a velocity as to create a very heavy swell in the harbor. Starting, then, with a breakwater from Battery Point, I would suggest that it be run in a south southeast (S.SE.) direction for a distance of 2,117.25 feet to a point marked A on the Coast Survey chart appended; thence in a direction slightly south of east for a distance of about 850 feet to B; thence in a direction slightly north of east for nearly 800 feet to C. This would be the most economical breakwater, giving the greatest extent of harbor that I think could be constructed there. It would be built on a natural shoal for its entire length; nearly all the dangerous rocks would be to the seaward of it; the reef outside would materially assist in breaking the force of the waves before coming in contact with the breakwater and it would be a good anchorage ground, with plenty of water inside for vessels. Should the breakwater be constructed in the above direction there are two rocks namely, "Fauntleroy Rock," and one nearly east of it, and distant about 150 yards, which would require removal, as they are near the head of the breakwater. Both of these rocks are long and slender, with deep water on all sides of them. The expense of removing them would be slight. Metamorphic sandstone can be obtained in any quantity, and of sufficient size for building this breakwater, by quarrying from the spur of a mountain, distant from Battery Point about five miles. This spur is owned by a Mr. Gay, who has consented to allow the United States to take what stone they may need for the breakwater free of charge. A railway would have to be constructed from this quarry to Battery Point; it would require but little grading, as a good wagon road is already constructed between the two points, and there is no difficulty about obtaining the right of way. I examined the country within five miles of Crescent City, but could find no stone of suitable quality any nearer than that above mentioned. Whaler island, in the harbor, contains over 22,000 cubic yards of rock, but the rock contains too much silica and quartz to be used for breakwater purposes. There are no facilities in the vicinity of Crescent City for machinery or labor. Timber is found in abundance. It was suggested by you that the top of the breakwater be thirty feet wide, with an inward slope of about forty degrees, and a seaward slope of about twenty-five degrees from the horizontal. This would require for the entire breakwater, as suggested, 323,664 cubic yards of material; the first section, viz, that from Battery Point to A, being 2,117.25 feet in length, having an average depth of 28.3 feet; the other sections, from A to C, being 1,637.34 feet in length, having an average depth of 31.7 feet. This would place the top of the breakwater five feet above the highest known tides. I am led to believe, however, from the construction of previous breakwaters, (Cherbourg, France, and our Delaware breakwater,) that a slope of twenty-five degrees to the seaward will hardly suffice. In some places, on the outer face, it should be less, in others greater than twenty-five degrees, depending on the violence of the action of the waves on these points. From the "report on the British harbors of refuge," where is found a description of various breakwaters, including the Delaware breakwater, I have estimated the amount of material which would be required in the construction of the Crescent City breakwater, giving it a seaward slope, the same as that of the Delaware breakwater, (see drawings annexed,) and find that it would require 409,914 cubic yards of material. Rock can be quarried and placed at Battery Point at $3 47 per cubic yard; this would

cost	$1, 422, 401 58
On the supposition that it would require 100 men six years to complete the breakwater, working six months in the year, at $5 50 per day, (currency)	602, 250 00
Construction of two lighters for depositing rock	8, 300 00
Machinery for handling rock	6, 500 00
Tugs for moving lighters	40, 000 00
Contingencies fifteen per cent	98, 557 50
Total in currency	2, 178, 009 08

Respectfully submitted:

W. H. HEUER,
Lieutenant of Engineers.

Brevet Lieut. Col. R. S. WILLIAMSON,
Major of Engineers.

APPENDIX T.

Report of Brevet Brigadier General N. Michler, Major of Engineers, United States Army, in charge of Public Buildings, Grounds, Works, &c.

OFFICE OF PUBLIC BUILDINGS, GROUNDS, AND WORKS,
CAPITOL OF THE UNITED STATES,
Washington, October 1, 1867.

GENERAL: On the 16th of October, 1866, I had the honor to submit my annual report for the fiscal year ending on the 30th of June of that year. At that time it was stated that plans of the military operations in front of Petersburg and Richmond, including detailed drawings of forts, redoubts, batteries, and mines, and topographical sketches of the various battle-fields from the Rapidan to Appomattox Court House, together with a large number of maps of the country exhibiting the lines of march of the contending armies, were in course of construction. The surveys cover an area of nearly fifteen hundred square miles. The following brief recapitulation will show the number of sheets, their different scales, and the several sections into which the whole field of operations is subdivided:

I. The general maps, two inches to the mile, represent the country between Cold Harbor and Appomattox Court House, comprising thirteen sheets.

II. The detailed maps are on a scale of eight inches to the mile, twenty-nine in number; eight illustrating the intrenched positions in front of Petersburg, and the remainder the lines of works around Richmond and along the James river above its junction with the Appomattox.

III. Ten sheets, scale of four inches to the mile, exhibit the most important battle-fields, comprising the Wilderness, Spottsylvania Court House, Tolopotomy, Cold Harbor, Five Forks, Jetersville, Sailor's Creek, Farmville and Appomattox Court House.

IV. Thirteen sheets, one inch to the mile, show the original maps issued at the commencement of the campaign of 1864.

V. Three sheets of sections of the last mentioned issue, corrected and distributed on the march.

VI. The index sheet, scale $\frac{1}{250000}$, is a general map of the country lying east of the Alleghany mountains, and extending from the battle-field of Gettysburg on the north, to the South Side Railroad of Virginia, on the south.

VII. One hundred and eleven drawings of forts, redoubts, batteries and mines, the scale of the respective plans being forty feet to one inch. The entire portfolio numbers one hundred and eighty sheets of antiquarian, embracing not only all the operations during the war of the army of the Potomac, but also of the army of the James and of the several detached commands engaged in Virginia.

At this date the maps are entirely completed, with but two or three exceptions, the surveys having been made with great accuracy and the topographical features of the country delineated on them with great care.

Whilst engaged in superintending the construction of these military maps, I was, in addition to that duty, detailed to carry out the directions of the Committee on Public Buildings and Grounds of the Senate of the United States relative to the selection of a suitable site for a public park and presidential mansion.

The views of the committee were imparted by its chairman, Hon. B. Gratz Brown, in several communications, of the 24th and 26th of July, addressed to the honorable Secretary of War; he therein requested that an engineer officer be placed in charge of the preliminary surveys of certain tracts of land adjoining or near the city of Washington, the preparation of the necessary maps and reports for the purpose above named, which, in the language of the Senate resolution of the 18th of the same month, "shall combine convenience of access and healthfulness, good water and capability of adornment;" in addition to this to ascertain, if practicable, the price of said lands. After a careful examination of the many beautiful localities to be found in the vicinity of the capital, and having caused an accurate and detailed survey of its environs to be made, I had the honor to address a communication, dated January 29, 1867, to the chairman of the committee, submitting for his consideration the result of my investigations. In connection with that report two preliminary maps were presented, showing, more plainly than words can express, the required information and the respective advantages of the different sections surveyed. A copy of my report is herewith appended, (Senate miscellaneous document No. 21, second session, thirty-ninth Congress,) together with reduced photograph copies of the now complete topographical sketches accompanying it. It will not be necessary to accumulate words, after so much has been written and so ably spoken in advocating an improvement so essential to the comfort and pleasure of every enlightened community. The attentive perusal of the very comprehensive remarks and beautifully expressed sentiments delivered by the honorable chairman of the Committee on Public Buildings and Grounds in the Senate of the United States, on the 20th of February of this year, concerning the bill for the establishment and maintenance of a grand national park in the District of Columbia, at the expense of the United States government, will convince the most prejudiced judgment. It will not fail to urge the earliest action of Congress in carrying out the hopes expressed by the honorable senator, already almost unanimously concurred in by the Senate, as well as the earnest wishes of those most interested in the adornment of the capital of a great nation, that no unnecessary delay may occur in passing the needful laws for accomplishing such a grand and beautiful undertaking. A copy of Mr. Brown's speech, together with the bill reported from the Senate committee to establish a public park in the vicinity of Washington city, are herewith appended; the bill passed the Senate, but was laid on the table of the House of Representatives during the last hours of the session.

By the second section of an act of Congress approved March 2, 1867, "the duties heretofore imposed by law upon the Commissioner of Public Buildings are devolved upon the Engineer Bureau, as well as the Superintendent of the Washington Aqueduct, and all the public works and improvements of the United States in the District of Columbia not otherwise provided by law." I had the honor, by engineer department orders dated March 13, 1867, to be assigned to execute the duties above stated, and at once to enter upon their performance. Immediately upon the receipt of these instructions, I called upon the Secretary of the Interior and the late Commissioner of Public Buildings, and received from them all the books, records, archives, and papers pertaining to the office of Commissioner of Public Buildings, and to the public works referred to in the act cited, and at once proceeded to the discharge of the duties appertaining to each of them. These are of such a diversified character that this report will only refer to the most important ones, and these in most general terms. I shall first consider such works in course of construction or undergoing repairs which are already authorized by different acts of Congress, and will then suggest some additional improvements in connection with the growth of the city as appear to be eminently necessary and ornamental. The different bridges across the Potomac and the Anacostia, or Eastern Branch, have either been rebuilt or placed in as good repair as the limited amount of the appropriations would admit. The one familiarly known as the Long bridge is, by actual measurement, four thousand six hundred and sixty-one feet. The sections are differently constructed, and of the following lengths:

First, built on piles	1,960 feet.
Second, draw (north side)	134 feet.

Third, gravel road on causeway	1,967 feet.
Fourth, draw (south side)	148 feet.
Fifth, brace and frame work, supported by cribs	452 feet.
Total	4,661 feet.

It will be remembered that in consequence of the heavy masses of ice which lay against and crushed the bridge at different points, it had been rendered impassable for some months. The appropriation of fifteen thousand dollars enabled me to place it in such repair as to allow travel across it to be resumed. Much more work is still required to make it stand until a more substantial, suitable, and architectural structure be built to span this magnificent river. I have been ordered to prepare a special report to the bureau in regard to the improvements of the channel of the river, and surveys are now progressing to show what changes have recently taken place; the bridge question is so intimately associated with this subject, that it will necessarily form a part of the discussion. The first section of the bridge is in very good condition, having been recently placed so; the second (north draw) will have to be rebuilt, as the timbers are decaying, and a more solid support must be substituted for the present pile one; the third is in good repair—the brick side-walls are damaged in many places, and require attention both for safety and appearance; the fourth (south draw) is in good working order; the fifth requires so many repairs as to almost necessitate the entire rebuilding of that portion. Although in much better condition, it is said, than for many years past, still it is doubtful if it can stand against the ice and freshets of another winter. An early appropriation, an estimate of which is respectfully submitted, is earnestly urged, as the work should be commenced without unnecessary delay.

The bridge over the Potomac, near the Little Falls, is in a most dilapidated condition. Having been greatly used during the war, with little or no care taken to keep it in good preservation, it is now in danger of giving way; the timbers of most of the spans, especially the three nearest the Virginia shore, are much worn and decayed. The bridge should have been covered to protect the wood, and the latter whitewashed to keep it sound. The flooring is much worn, and travel over it has become dangerous; only by the most careful attention on the part of the watchman can accidents be avoided. It would probably be economy to take the bridge down and rebuild it. An estimate of the cost of repairing has been carefully prepared and submitted.

The lower or navy-yard bridge and the upper or Benning's bridge, over the Anacostia or Eastern Branch, are now both in good condition; the former has been recently renovated, and the latter substantially rebuilt. Neither of them for many years will require any extensive repairs; the flooring alone will have to be replaced from time to time. The large amount of the various commodities for market which pass over each of the several bridges enumerated, and the necessity for which so materially interests the largely increasing population of the city, will surely recommend favorable action upon the appropriations for their prompt and speedy improvements. Major T. Lubey, one of my assistants, has had the immediate supervision of these works; he has always given prompt attention and general satisfaction in carrying out my instructions.

The fence around the botanical garden has been advanced as far as the appropriation will admit; about eleven hundred and thirty feet are finished. The upper part is of iron, and the lower of brick; the latter rests upon a stone foundation, and is covered with a fine North river flag coping. Two additional faces of the grounds have still to be enclosed with a similar fence. The pavement on the north front (the south side of Pennsylvania avenue) should be regraded and repaved, as it is now much below the grade of the avenue. A pavement should also be laid on Maryland avenue, along the south front. These improvements, which should be of flagging, will greatly add to the general appearance of the grounds. A very beneficial change is being effected by the construction of a culvert through the garden, which converts the exposed bed of the lower portion of Tiber creek into an extensive sewer. This work will not only remove a disagreeable feature from the sight of the many visitors who frequent the conservatories of rich and rare exotics as well as native plants there collected and arranged, (under the special care of Mr. W. R. Smith, for many years the superintendent of the botanical garden,) but will also aid in improving the sanitary condition of a section so nearly contiguous to the grounds surrounding the very Capitol of the nation. It would be well if the same system could be adopted in covering from sight and smell that pestiferous ditch of water styled the "Washington City canal," into which the Tiber empties. This canal will be referred to in a subsequent part of this report. It is to be very much regretted that the culvert cannot be completed this year, owing to the limited means on hand. Of the appropriation for the fiscal year ending the 30th of June, 1867, over seven thousand dollars was applied to other works by the late Commissioner of Public Buildings, and of that for the fiscal year ending June 30, 1868, the whole amount has been expended, without finishing it. An estimate for enabling me to do so is submitted. Owing to the large extent of land drained by the Tiber, a great accumulation of sand, gravel, and some very deleterious substances are washed down and deposited in the bed of the stream, throughout the length of the culvert, and into the canal. Some action should be taken to arch over this stream from where it crosses Pennsylvania avenue to the extreme northern limits of the city; the same reasons apply that have been given for covering the lower portion. In addition, some system of gravel pits and dams, for collecting the washings of the soil, should be arranged at different points, and the banks protected by sodding or masonry. The management of the Tiber must be treated in the light of a main sewer for a large and growing section of the city, and all improvements projected with that object in view. During the second session of the thirty-ninth Congress a bill was introduced in the Senate of the United States to arch Tiber creek.

The pavement of flag stones laid along Pennsylvania avenue and Seventeenth street in front of the War and Navy Departments, forms one of the best and most needed improvements in that portion of the city; it has given most general satisfaction, and should be still further extended along the street towards and around the south front of the President's grounds. Several very important renovations have been attended to during the summer at the Executive Mansion, and the building is now in very excellent order. The conservatory, a large part of which was destroyed by fire and the remainder of the framework decayed by the constant moisture of the heating apparatus, has been almost entirely rebuilt; the wing of the main structure requires to be thoroughly overhauled. It is to be regretted that a larger appropriation was not made in order that the old greenhouse might have been removed, and a more ornamental and tasteful one erected. Most of the valuable and rare plants, which so pleased and gratified the tastes of the many visitors from every part of the country, were destroyed by the fire which nearly consumed the building; to replace these, and to make important additions to them, will require an expenditure of several thousand dollars, which no doubt the liberality of Congress will furnish. The furnace of the Executive Mansion has been thoroughly examined and repaired, and some needed changes made in the apparatus for better regulating the distribution of the steam for heating. The roof of the mansion is also being placed in better condition, and many minor matters attended to. A larger appropriation is asked for annual repairs for the next fiscal year, as experience has taught me that the present one is entirely inadequate for so extensive a building.

PUBLIC SQUARES AND RESERVATIONS.

The plan adopted by General Washington for laying out the city of Washington consists of wide streets and avenues intersecting each other; the former, running from north to south, designated by numbers, and from east to west, called by letters, cross each other at right angles, and are again cut diagonally by avenues bearing the names of the different States of the Union. In consequence of this system many public places have been formed, consisting of circles, triangles, and squares; in different parts of the city sections are set apart as reservations for the benefit of citizens and for public buildings. Many of these have already been beautified, and the remaining ones should be improved as early as possible; while adding so much to the appearance of the city, they at the same time largely contribute to the health, pleasure, and recreation of its inhabitants. The grounds immediately about the President's house are in excellent condition, and have been a favorite resort for many. The reservation to the south, and extending to the canal, generally known as the "White Lot"—the scene of so many games of ball—should now be laid out and included in the above. As the work on the Treasury extension is drawing to a close, the workshops, which have heretofore interfered with this improvement, can be removed, and the plans of adornment be extended. One of the most charming places for recreation is Lafayette square; it has been made very beautiful, but owing to the ground being so level there is defective drainage; by adopting a system of under-ground drains leading towards the southwest angle, and thence connecting by a sewer through the avenue with that on Seventeenth street, this objection can be remedied. A very marked change has taken place in the appearance of Franklin square, but still more has to be done. During the fall months it is proposed to set out a large number of deciduous trees, to further ornament the beds; a large number of evergreens have already been planted, and are in a flourishing condition. The square has already been under-drained, and the paths have been substantially laid. An iron fence is still needed to properly enclose it. The Circle at the intersection of Pennsylvania and New Hampshire avenues and K street west, also presents a most pleasing feature to the gaze. The grounds west of the Capitol are in excellent order, and form one of the great points of attraction both for citizens and strangers; those to the east have been very generally resorted to, large crowds collecting from time to time to listen to the music of the band which weekly performs there. In all of these comfortable lodges have been built for the watchmen. The enlargement of the grounds north and south of the Capitol is being made under the immediate direction of the architect of the Capitol extension; the roadway and paths on the east front should be handsomely paved. A recent and very interesting letter from General Meigs, now travelling in Europe, describes, in great detail, the style of pavement in use for public squares in several of the large cities, and should be adopted in our own capital; a copy of the letter is appended.

Most of the triangular places along the main avenues have been enclosed, and some of them very prettily ornamented with trees and shrubbery: a great deal more in the way of similar improvements should be attended to as soon as practicable, as they not only very much enhance the value of property, but afford for both rich and poor the means of enjoyment, Particular attention is called to Lincoln square, which has been simply enclosed by a paling fence; the beds and paths have still to be laid out, trees and shrubbery planted, and other important changes to be made. It is the only square in the eastern part of the city, and it is due to the increasing growth of that section, that steps should be taken at once to ornament the grounds. The vacant places at the intersections of Pennsylvania avenue with North and South Carolina, those where Georgia and Virginia avenues cross each other, and the square formed by the meeting of Maryland and Massachusetts avenues, should also be enclosed and improved. These are all east of the Capitol, a hitherto much neglected portion of the city as far as the general government is concerned. Extensive changes have taken place there in the last few months; streets have been opened and graded, gutters paved, curbs set, pavements laid, and many houses are being built.

Passing to that part of the city to the west of the Capitol the following suggestions are offered in regard to future improvements: The two triangular spaces on Vermont avenue between I and K streets have been united and now form one square, making a most agreeable alteration. It is proposed to make a corresponding square on Connecticut avenue between the same streets as soon as the frame buildings of the Freedman's Bureau, now occupying the public space, shall be removed. Circles should also be laid out on Vermont avenue where it intersects Massachusetts and Rhode Island avenues, and also at the intersection of Massachusetts, Connecticut and New Hampshire avenues. The value of these improvements can be scarcely realized. The reservation known as Judiciary square is sadly in need of embellishment; it can only be attended to when the frame buildings used by the medical department of the army are taken down. It is to be hoped that they can soon be dispensed with. Several prominent citizens, among others the General commanding the United States army and the mayor of the city, have urgently requested that a new square be opened on New Jersey avenue between H and I streets north. This is a very beautiful and commanding part of the city, and many valuable buildings have been erected, and others are still in course of construction. It is earnestly urged upon Congress to make an appropriation for purchasing the necessary ground. The triangular space located at this point belonged not many years ago to the government, but was sold by authority of one of the previous Commissioners of Public Buildings. In planning the city, a large reservation, known as Mount Vernon place, was laid out at the intersections of K street north with New York and Massachusetts avenues. Most unfortunately for the ornament and health of that part of the city, the original design has not been perfected. Eighth street has not only been opened through it, separating it into two parts, but on one of these divisions has been erected a most unsightly building for a market house. The latter, with its attending annoyances, forms an intolerable nuisance, which should be abated at once. On market days the most offensive matter accumulates in the adjoining streets, greatly detrimental to the health of the residents in the neighborhood. The refuse vegetable matter thrown from the wagons of the hucksters, and the offal from the stall of the butcher, mingle with the filth created by the many animals which are brought and allowed to stand around the place, causing a most disagreeable stench, especially in summer, and thereby engendering sickness. By what authority the market is located on this public reservation cannot be ascertained. It should be removed, and arrangements similar to those in all our large cities be adopted to supply the wants of the community. The grounds could then be improved and become what they were originally intended to be.

A nuisance similar to this has been created by the dilapidated and unsightly buildings on Pennsylvania avenue known as the "Centre Market." This too should be abated; it is not only a reflection upon the good taste of the community that such an old and objectionable structure should meet the gaze upon the principal avenue of the capital, but it is a disgrace to see this main artery, connecting the Capitol with most of the public buildings, obstructed by such a diversified and by no means pleasing collection of commodities as are usually offered for sale on every market day. Cannot a more suitable locality be found and one equally convenient of access? And cannot an ornamental as well as a commodious market be erected which will be a credit to the city? Something should be done towards improving the public spaces formed by the intersection of Pennsylvania and Louisiana avenues. As long, however, as the market wagons are allowed to occupy them it is useless to attempt any needed reforms. If the corporation does not take the necessary steps to remove the cause of this great nuisance by erecting a suitable and imposing structure, the government should resume control of the reservation for the purpose of improvement. It is still a matter of controversy whether the government has yielded its claim to it, and whether the corporation holds it by any other title or authority than that of actual possession.

But to proceed to the consideration of another of the reservations directly under my charge brings me to the large section immediately south of the canal, and reaching from near the Capitol west to the banks of the Potomac; these grounds are generally denominated "the mall." The extent of this reservation is greater than any other within the city limits, and is centrally located for the establishment of a limited park for a large part of the city. Only one portion of it has been tastefully laid out in accordance with the plan proposed by Mr. Downing in 1851, and approved by Mr. Fillmore, then President of the United States. A great deal of additional work has to be executed before perfecting the system adopted. Unfortunately the grounds are subdivided by several transverse streets running north and south; formerly there were but three of them—Seventh, Twelfth, and Fourteeenth—but lately, by direction of Congress, another, Sixth street, has been opened. Could these streets be made subterranean by tunnelling, the different parts of the mall could be thrown into one, and thereby furnish ample space. As this is not practicable, owing to the level nature of the ground, another plan might be adopted. Let the whole extent of the reservation be laid out in carriage ways, paths for equestrians, and walks for pedestrians, as if the different parts formed a unit; gates with their lodges could be placed where the different walks would pass from one section to another, the crossing of the streets between them being handsomely paved with flagging. The keepers of these gates, selected from the many dependent and worthy soldiers who have been disabled during the war by loss of an arm or leg, could, by some mechanical arrangement, manœuvre, while seated in their lodges, the gates, opening or closing them for the passer by. The government experimental farm would have to be removed to some more suitable place without the limits of the city, and the various frame buildings, used by the army during the war for hospitals, would have to come down. The basin at the mouth of the Tiber might be partially filled, thereby giving an increased number of acres, and suspension bridges could be built across the canal, uniting the grounds to those south of the presidential mansion. By some such plan beautiful and continuous drives could be had between the latter building and the Capitol, free from all the dust and noise and bustle of the busy streets of the city. The accompanying sketch will illustrate the ideas which I have endeavored to convey. It is to be hoped, too, in the event of such improvements, that action be taken by the association having the matter in charge towards the completion of the monument being raised to the memory of Washington.

Fountains.—In all the contemplated improvements of the public grounds of the Capitol, one very ornamental, as well as sanitary, feature should not be forgotten; the free introduction of water, as jets d'eau, fountains, miniature lakes, into each and all of them, will greatly enhance their charms by refreshing and cooling the heated atmosphere of summer, and by the preservation in all their natural beauty of the various shrubs and trees which adorn them. The abundant supply furnished from the great falls of the Potomac by the Washington aqueduct will be a never-failing source from which to obtain all that may be needed for such purposes. Groups of statuary should be artistically arranged throughout the grounds as another evidence of enlightened taste. Additional propagating houses should be built to furnish and replace the various plants needed for embellishment.

The Washington canal is a work upon which much has been written, and many suggestions offered in reference to its permanent improvement. All admit that in its present condition it is a great nuisance, extremely disgusting to the senses of both sight and smell. It is nothing more than an open sewer, constantly generating noxious gases, which are most deleterious to those not only residing immediately along its banks, but to the inhabitants of the entire city. Many plans have been proposed for cleaning it, the most impracticable and expensive having generally been adopted. An inspection will show how signally the last project—executed at an expense to the city of some sixty thousand dollars—has failed in accomplishing the much-needed reform. It is the main artery of the sewerage of the largest part of the city, it being the receptacle not only of the excrement and sediment of the sewers, but also of the surface drainage. In addition to this an immense quantity of material is washed into it at every heavy rain by the Tiber. No one can appreciate the large amount of deposits thus formed unless by actual examination. After carefully examining the subject, the following conclusions have been arrived at as the most feasible:

In the first place, the course of the canal should be altered at certain points, so as to remove all sharp angles, and its bed be excavated by dredging to such a depth as to bring the sole at least below the line of low tide of the river. A portion of the width of the canal along the north side should be then enclosed by a substantial wall, and arched over, converting it into a regular sewer. The river at high tide would, to a certain extent, aid in cleaning it; but a more efficient way would be to make free use of the aqueduct water for thoroughly flushing it at frequent and regular periods. The remaining section of the canal should be kept constantly dredged after the first labor of deepening it is executed; but very little additional work will be annually required. It could then be used for the ordinary purposes of trade, and also become an ornament to the city, instead of remaining the filthy water-course that it now is. As the sewers of all the public buildings empty into it, a proportional part of the expense of placing it in order should be borne by the government, and annual appropriations be made to keep it open and clean. A general system of sewerage should be adopted. In all other cities this subject commands more attention than any other. Whether the government, the corporation, or private enterprise undertake the work, it is absolutely necessary that it should be performed at once, and in the most thorough manner. An improvement, such as is now contemplated, will not only benefit the health of the city, but increase the value of property along it. Instead of the present unsightly structures and heaps of rubbish and dirt, magnificent mansions would spring up, embellished by beautiful gardens. What a great advantage it would be to the mall, the approaches to which are over the canal, the latter extending along its whole length on the north.

Being a member of a board of engineers instructed to examine an improved ship-lock, recently patented, in relation to "its adaptation to aiding in the construction of a ship-canal through the city of Washington," the subject of certain improvements in the present canal will probably be discussed at considerable length.

In addition to the public grounds, the officer in charge has the care and improvement of all the avenues, twenty-one in number, and certain of the streets passing through or adjoining them. Many of these have been opened, and it is respectfully recommended that authority be given to improve the remaining ones. They form the direct line of communication between different sections of the city, and between many of the public buildings and grounds. In justice to property holders along them, and for the public convenience, the grades should be established as soon as practicable, that each may know the condition of his property before planning any new improvements; the roadways should be placed in good travelling condition. Massachusetts, New Hampshire, Connecticut, New Jersey, Vermont, Delaware, New York, and Maryland avenues should be graded. But two appropriations were made during the second session of the thirty-ninth Congress for this purpose. That "for grading and repairing Virginia avenue" has been applied to the repairs lying between Sixth and Ninth streets east. By an arrangement made with General O. O. Howard, Commissioner of the Bureau of Freedmen, the work has been extended; the grading and gravelling has been completed to Tenth street, and the grading as far as Twelfth street. Part of the following square has also been graded, the necessary excavation furnishing a very superior gravel to form the superstructure of other portions of the avenue. When the appropriation was nearly exhausted General Howard offered to furnish a certain amount to enable me to employ laborers to continue the work, paying the men out of funds donated for the support and relief of indigent freedmen, and intrusted to him for distribution; the balance of appropriation remaining on hand was then applied to the hire of carts. This work has been most substantially done, and very creditably to Captain T. A. Stone, who has had the immediate superintendence of it. The advantage of opening and improving this avenue is already experienced; a large amount of the travel crossing the lower bridge, over the Eastern Branch, is now diverted from Pennsylvania avenue, east of the Capitol, finding other ways of approach to the markets of the city. Forming with Massachusetts and Pennsylvania avenues parallel roads throughout its entire extent, between the Eastern Branch and Georgetown, the improvements should be continued, and an estimate has been submitted for that purpose.

The oldest and greatest thoroughfare from one limit of the Capitol to the opposite one, connecting the most important public buildings and grounds, is Pennsylvania avenue; a glance at the map shows that it is the most central. In consideration of the great importance of this avenue, the relative position it bears to all the avenues and streets, which either diverge from it in every direction or intersect it along its entire length, some most marked improvements should be inaugurated to render it as great and beautiful in appearance as it has proved to be necessary and accessible. The very limited appropriation has enabled me to make only such repairs as were most needed; some sections had become almost impassable, either from the effects of the weather, or from having been cut up by the immense amount of travel over them, or from both causes combined. It is now only in tolerable order, although it is said to be in much better condition than for many years past. The seat of government of a nation should be able to boast of at least one magnificent avenue; that part extending from Rock creek, its boundary on the west, to that splendid pile of architecture, the Capitol, should receive the advantages of the most improved road-way. There is scarcely a street or avenue in the city over which one can drive with ease and comfort; it is only lately that the Belgian pavement has been laid to any extent, and the agreeable contrast experienced between it and that of old-fashioned cobble-stone cannot be but appreciated by all. The numerous deep gutters, which cross the streets of Washington in every block, cause constant wear and tear to both horse and vehicle; it is to be hoped that at no very distant day the drainage of the entire city will be underground, and that a more even surface for driving may be obtained. The streets of a city are public property, in which all citizens are more or less interested, and in point of necessity no other public work can equal them; why, then, is not more attention paid to paving and ornamenting them? "The paving of streets is of early date, and is in fact necessary to any considerable degree of civilization and traffic. The Romans paved their streets in the same elaborate and solid manner in which they paved their highways." Portions of the ancient pavement of the streets of that city are in use at the present day, and that of Pompeii remains entire. In one of the pamphlets on the subject of pavements it is well remarked that, "considering the present development of the arts and sciences, there is no reason why the city streets should not be as agreeable for walking and pleasure riding as the roads in the Central Park; and, at the same time, be so substantially paved as to meet all other requirements." In consideration of all these facts, and the great importance of having at least one good pavement traversing the city, the recommendation is made that the present cobble-stone pavement be removed, and that Pennsylvania avenue, west of the Capitol, be relaid with either one or the other of the improved pavements now coming into general use. If stone is to be used, the Belgian pavement possesses the greatest advantage; but should one of wood be preferred, which is delightful, easy and not noisy, either the Nicholson, Ream, Fayette, or Stafford will prove to be as near perfection as it is possible to construct them. Then again the Asphaltum, the Concrete, and other similar pavements have their advantages in certain climates. Each one of those named has its advocates, and their relative merits, in both a practical and economical view, should be severely tested by competitive comparisons, made under the same and equal trials, both as regards climate and use. Pamphlets have been printed describing the benefits of each, and all can find an opportunity of testing them by actual experience. It is unnecessary to describe them in this report. The length of that part of the avenue which it is proposed to improve is over two and a half miles, and averaging in superficial measurement about one hundred and ninety-six thousand square yards. The cobble-stone pavement to be removed can be used on other and less frequented avenues.

Although the nation at large is deeply interested in the general improvement of the metropolis of the republic, and especially in the accomplishment of such a great and much needed work, still the property-holders along the avenue, as well as the citizens generally, are mostly benefited by it; the expense of constructing an improved pavement might, therefore, be equitably proportioned between the municipal and general government. In addition to laying a good carriage way, other advantageous changes might be introduced for the beautifying of this avenue. The great widths of the avenues and streets in Washington offer many reasons, both in an ornamental and in an economical consideration of the matter, for imitating the taste and utility displayed in some of the larger cities of Europe. The "Unter-der-Linden," as described in the letter from General Meigs, previously referred to, "is a street of great celebrity in Berlin, and the people are still praising the electors who laid it out two hundred years ago. It is the principal street of a city of six hundred thousand inhabitants; upon it are the royal palaces, those of most of the princes, the principal shops and hotels. It has a wide gravel walk in the centre, four rows of trees which give shade, wide sidewalks next the houses, and yet it is never encumbered. The central walk is sometimes filled in the evening by citizens and strangers enjoying the long summer twilight of this northern latitude, in which darkness does not come on until 10 p. m." The general gives a sketch of it, and hopes that Pennsylvania avenue may yet be arranged like it. The following are the dimensions of the different parts into which it is divided: First, foot-path, paved, adjoining houses, 15 feet; second, carriage-way, paved, 33 feet; third, line of stone posts, 3 feet; fourth, row of trees; fifth, carriage-way and equestrian-way, paved, 24 feet; sixth, row of trees; seventh, promenade, gravelled, 60 feet; eighth, row of trees; ninth, ride, gravelled, 24 feet; tenth, row of trees; eleventh, line of stone posts, 3 feet; twelfth, carriage-way, paved, 33 feet: thirteenth, foot-path, paved, 15 feet. These measurements give the width of the Unter-der-Linden at two hundred feet; Pennsylvania avenue is one hundred and sixty. The trees are not very large, having perished in the occupation of the city by hostile armies, and repeatedly renewed. If the thirty-three feet carriage-way happens to be full or obstructed, carriages take the twenty-four feet lines between the trees; but these twenty-four feet lines are ordinarily used only by equestrians and by parties who drag their wagons assisted by their dogs. One of them, that on the north side of the promenade, is gravelled, to be used as a summer road. This street is the resort for business and recreation of all Berlin, and of all strangers.

Is it not possible, in view of any contemplated improvement of Pennsylvania avenue, to adopt some of the plans proposed for ornamenting this prominent thoroughfare, and relieving it from its present unfinished appearance? Besides the improvements already suggested, there is another which should receive prompt action. From an examination which was made by my direction, Mr. Theo. B. Samo, engineer of the Washington aqueduct, reports that "between First street west and Fifteenth street west, on Pennsylvania avenue, there are fifteen fire-plugs; thirteen are similar in construction to those known as 'New York plugs;' each one is connected with a pipe, designated as the 'four-inch' or 'spring-pipe.' The other two are Philadelphia plugs, and are connected with the twelve-inch government mains." "The four-inch pipe is an old pipe nearly worn out, and is connected with the twelve-inch main only at Third street west and Thirteen-and-a-half street west. Not more than two plugs can be supplied by it at once, owing to its small diameter and the distance between its connections." It is respectfully suggested that the New York plugs, which are too small and have been constantly out of repair, should be replaced by those of more improved make and facilities; a new six-inch pipe should be laid in the place of the four-inch, and more frequent connections made with the twelve-inch main, in order that a sufficiency of water may be had in case of fires. At present, the steam engines have to obtain their supply from other streets. The cost of replacing the old plugs is comparatively small, considering the great amount of interest at stake, and an estimate is herewith submitted.

The relation of the general government to the city of Washington is very ably set forth in two very interesting pamphlets, the one addressed by the mayor of the city, in November, 1865, to the Hon. James Harlan, then Secretary of the Interior, and the other is a copy of the remarks which originally appeared in the editorial columns of the Union. The fifteenth section of an act of Congress approved the 15th day of May, 1820, "incorporating the inhabitants of the city of Washington," and the third section of an act approved May 5, 1864, amending the previous one, directs that "in all cases in which the streets, avenues, or alleys of the said city pass through or by any property of the United States, the Commissioner of Public Buildings shall pay to the duly authorized officer of the corporation the just proportion of the expense incurred in improving such avenue, street, or alley which said property bears to the whole cost thereof, to be ascertained in the same manner as the same is apportioned among the individual proprietors of the property improved thereby." Under the authority of these acts a large sum is due for the many improvements which have been completed, or are in course of construction, by order of the corporation; the late Commissioner of Public Buildings presented claims amounting to more than ninety thousand dollars, for which an appropriation has never been made; and only recently the mayor has officially informed me of the cost of additional works throughout the city; the latter have been personally inspected and approved. As it is contemplated to continue these improvements during the coming year, it is important that provision be made in advance to have ready in the hands of the officer in charge sufficient funds to pay the government proportionate part. Unless this is done, the advance of improvement is obstructed, and great suffering is sometimes caused by the inability to pay the wages of the laborer. Instead of appropriating money for the immediate care of the indigent and poor, it would perhaps be better policy to inaugurate improvements so as to enable them to obtain work and gain their own support.

In the hands of honest officers this plan will work well; public works should be, in more senses than one, public benefactors. Before concluding the brief suggestions offered in reference to the improvement of the different avenues, especial attention is called to Boundary street, towards which many of them lead; this street forms a connecting link between them, and at the same time skirts a greater part of the limits of the city. It is capable of great embellishment; by increasing the width and planting along it rows of shade-trees, it will become a most delightful and much-frequented drive.

Many nuisances have been abated throughout the city by authority of the acts of Congress referred to, for the payment of which several public lots have been offered for sale, and some small appropriations are desired.

During the last winter an act passed to increase the supply of water in the Capitol building. For accomplishing this object in a proper manner the sum appropriated was not sufficient. By means, however, of certain funds at the disposal of the architect in charge of the extension, and which are applicable for the purpose, the work is progressing, and will be completed before the assembling of Congress. Owing to the great quantity of water daily used in the machine-shops of the navy yard, supplied only by the twelve-inch main, many complaints have been made of the great scarcity, during working hours, throughout the eastern section of the city. This can be easily remedied by connecting the twenty-inch main, now being laid in North B street for the benefit of the Capitol, with the twelve-inch main on First street east. An additional appropriation is asked for this much needed improvement. To meet the demands of the constantly increasing growth of the northern part of the city, another main will soon have to be brought into that section from the distributing reservoir near Drover's Rest. In his last report the mayor calls attention to the necessity of introducing an additional supply of water to meet this increased want.

In addition to the duties appertaining to the office of the late Commissioner of Public Buildings, the superintendence of the Washington aqueduct also devolved upon me. This most important work has for several years been under the general control of the Department of the Interior, Mr. Theodore B. Samo, the engineer in charge, having had for the last two years the immediate direction of all engineering operations. His very concise report for the year ending September 30 furnishes in detail the progress of the several supplemental works in course of construction, and also makes such recommendations as are necessary for the thorough completion of the entire aqueduct. It is very gratifying to have it in my power to report the very able and conscientious manner in which he has discharged his duties, and, after very careful inspections of the entire work, to coincide with him in the views entertained in relation to its progress, and to approve of the estimates submitted for the completion of many important parts upon which labor has been suspended for want of the necessary appropriations. Certain tracts of land are occupied by the government for aqueduct purposes, for which, in some cases, only nominal rents are paid; in others no rents have been paid at all, and claims are now being made by the owners to become either repossessed of their property, or to be paid for its use. As the United States must retain the few acres for the benefit of this national work, it is earnestly urged that authority be given to purchase them. But a few thousand dollars is needed to meet all claims and to purchase the land. The great importance of introducing into the capital an unlimited supply of pure and wholesome water cannot be overestimated. The large amount of valuable public property concentrated in the city, amounting in the aggregate to millions of dollars; the immense accumulation of important government archives, many of them stored away in buildings which are not fire-proof; the large number of public buildings, will certainly show the necessity for the

Washington aqueduct, and that no expense should be spared in completing it. The water thus supplied has become a great motive power at the different government works throughout the city, and should the capital of the nation become what every enlightened citizen should desire to see it, a still larger demand will be made for both useful and ornamental purposes. As a member of a board of officers to select a site and prepare plans and estimates for a new War Department building, it was ascertained that this department alone occupied a great many buildings, and, with the exception of one, all are unsafe and not constructed for protection against fire; it will require a very large fire-proof building to preserve free from accident its valuable archives. In the safety and preservation of these almost every family in the land is interested.

The repairs of Fort Foote, on the Potomac, which are progressing under the mmediate direction of Mr. S. T. Abert, civil engineer, were also placed under my temporary superintendence. One of the most charitable and disinterested appropriations which the officer in charge of public buildings is called upon to disburse is that for the care of such transient paupers as are in need of medical advice and treatment; a home is also furnished, where proper care and nursing, and suitable nourishment, can be given at all times. Arrangements have been made with Providence Hospital to admit a limited number of patients; although at times the quota is exceeded, still they are always kindly received and the best of attention given them. To know and to appreciate that such is the case it needs only to be mentioned that the hospital is under the efficient control of the Sisters of Charity. Before concluding this already extended report it is respectfully recommended that additional clerical assistance be allowed in this office, and that the number of assistants and laborers under the public gardener be increased; the former should be excellent accountants, and the latter men who thoroughly understand the care and beautifying of the public squares.

As an inducement to obtain experienced and reliable persons compensation commensurate with their services should be afforded them; the present pay as authorized by law is not deemed sufficient, and it is earnestly urged that an increase may be granted. Major James Nokes, the public gardener, and his assistants and laborers, have faithfully performed the labors required of them in the care of the different squares and reservations, the appearance of which will also testify to the skill displayed by them. The assistants in the different offices connected with public buildings, grounds, and walks all deserve great credit for the manner in which they have severally performed their duties.

Most especially to my general superintendent, Mr. B. F. Burns, much praise is due for the efficient, faithful, and competent manner in which he has at all times carried out my instructions.

I am, general, very respectfully, your obedient servant,

N. MICHLER,
Major of Engineers, Brevet Brig. Gen. U. S. A., in charge.

Major General A. A. HUMPHREYS,
Chief of the Corps of Engineers, U. S. A.

APPENDIX T—1.

REPORT IN RELATION TO "PUBLIC PARK AND SITE OF PRESIDENTIAL MANSION," APPENDED TO ANNUAL REPORT DATED OCTOBER 1, 1867, OF BREVET BRIGADIER GENERAL N. MICHLER, IN CHARGE OF PUBLIC BUILDINGS, GROUNDS, AND WORKS, WITH ACCOMPANYING SKETCHES.

Communication of N. Michler, major of engineers, to the chairman of the Committee on Public Buildings and Grounds, relative to a suitable site for a public park and presidential mansion, submitted to accompany the bill (S. 549) for the establishment and maintenance of a public park in the District of Columbia. February 13.

WASHINGTON CITY, *January* 29, 1867.

SIR: In compliance with the contents of your letters of the 24th and 26th of July, 1866, addressed to the honorable Secretary of War, I was detailed by the Chief of Engineers, with the consent of the General-in-chief, to carry out the views of the committee in regard to the special duty assigned me. In the letters referred to you requested that an engineer officer be detailed to make the necessary preliminary surveys and maps of certain tracts of land adjoining or near this city, for the purposes of a public park, and also a suitable site for a presidential mansion, and which, in the language of the Senate resolution of the 18th of the same month, "shall combine convenience of access and healthfulness, good water, and capability of adornment;" in addition to this to ascertain, if practicable, the price of said lands.

After a careful examination of the many beautiful localities to be found in the vicinity of the capital, and having caused an accurate and detailed survey of its environs to be made, I now have the honor to submit for your consideration the conclusions to which I have arrived. In connection with this report two preliminary maps have been prepared, which will show more plainly than words can express the required information and the respective advantages of the different sections. The Senate resolution would seem to imply that one and the same tract of land should be designated for a site for grounds for a presidential mansion as well as for a public park; but as it is not definitely so stated, it has been judged best by me to separate the subjects. Should such not be the intention of your honorable committee it will be easy to combine the two, where so many splendid situations present themselves from which to make a selection. As it is designed to build a home for the President to which he can retire from the active cares and business of his high office, and where he can secure that ease, comfort, and seclusion so necessary to a statesman, it would seem best to locate it away from the constant turmoil of a city life, at such a distance where his privacy cannot easily be intruded upon, and still sufficiently accessible for all practical purposes.

In the first place let me consider the subject of a public park. Where so much has been written on so interesting a feature to any large city as that of a park, and where the necessity of public grounds, either for the sake of healthful recreation and exercise for all classes of society, or for the gratification of their tastes, whether for pleasure or curiosity, has become apparent to every enlightened community, it would seem to be unnecessary for me to dilate further upon the matter, to say nothing of the natural or artificial beauties which adorn a park, and so cultivate an appreciative and refined taste in those who seek its shades for the purpose of breathing the free air of Heaven and admiring nature. It certainly is the most economical and practical means of providing all, old and young, rich and poor, with that greatest of all needs, healthy exercise in the open country.

To accomplish these ends there should be a spaciousness in the extent of the grounds, not merely presenting the appearance of a large domain, but in reality possessing many miles of drives and rides and walks, all independent of each other, and either open or protected so as to be suitable for the different seasons. There should be a variety of scenery, a happy combination of the beautiful and picturesque—the smooth plateau and the gently undulating glade vying with the ruggedness of the rocky ravine and the fertile valley, the thickly mantled primeval forest contrasting with the green lawn, grand old trees with flowering shrubs. Wild, bold, rapid streams, coursing their way along the entire length and breadth of such a scene would not only lend enchantment to the view, but add to the capabilities of adornment. While nature lavishly offers a succession of falls, cascades, and rapids to greet the eye, as the waters dash through some romantic dale, the hand of art can be used to transform them into ponds and lakes as they gently glide through the more peaceful valleys, thereby rendering them the means of pleasure and recreation for boating or skating. What so useful as an abundance of water, or so ornamental when converted into fountains and jets to cool the heated atmosphere? It furnishes, also, opportunities for the engineer and artist to display their taste in constructing ornamental and rustic bridges to span the stream.

An attempt has been made in a few words to describe the purposes and beauties of a public park. In no place has nature been more bountiful of her charms than in the vicinity of this city, and all can be found so near and accessible; the valley of the Rock creek and its tributaries, the Broad and Piney branches and the several minor rivulets, with the adjoining hills overlooking these beautiful streams, present the capital of the nation advantages not to be lightly disregarded in providing a park worthy a great people. All the elements which constitute a public resort of the kind can be found in this wild and romantic tract of country. With its charming drives and walks, its hills and dales, its pleasant valleys and deep ravines, its primeval forests and cultivated fields, its running waters, its rocks clothed with rich fern and mosses, its repose and tranquillity, its light and shade, its ever-varying shrubbery, its beautiful and extensive views, the locality is already possessed of all the features necessary for the object in view. There you can find nature diversified in almost every hue and form, needing but the taste of the artist and the skill of the engineer to enhance its beauty and usefulness; gentle pruning, and removing what may be distasteful, improving the roads and paths, and the construction of new ones, and increasing the already large growth of trees and shrubs, deciduous and evergreen, by adding to them those of other climes and countries. A list of the various trees and shrubs, and vines and creepers, to be found already flourishing in the region described, and also the nature of the soil, will be appended to this report. A glance at the map will show the topographical features of the country, and its accessibility to both Washington and Georgetown.

The valley of Rock creek occupies a central position to both, as it lies between the Tennallytown road on the west, one of the most prominent thoroughfares leading out of the one city, and the Fourteenth street road and Seventh street turnpike on the east, two of the finest communications running in a northerly direction from the other. From these main highways many branches cross the valleys or follow along the banks of the stream; these transverse roads already form beautiful drives. Rock creek winds along for more than four miles through the centre of the proposed grounds, receiving at convenient points the waters of the Broad and Piney branches, and several smaller tributaries. For a short distance it courses through a narrow but beautiful valley, then wildly dashes for a mile over a succession of falls and rapids, with a descent of some eighty feet, the banks on both sides being bold, rocky, and picturesque; then passes again through narrow valleys or between high, bluff banks. At many points the creek is capable of being dammed, thus forming a series of lakes and ponds for useful and ornamental purposes. The many deep ravines setting in towards it can furnish romantic walks and quiet retreats for the pedestrian. The larger part of the ground is thickly wooded, and capable of great adornment. Here we find the several varieties of oak, the beech, the locust, the mulberry, the hickory, the sassafras, the persimmon, the dogwood, the pine, with a great many shrubs, vines, and creepers, growing, climbing, and trailing throughout the woods. Beautiful vistas, artistically arranged, can be cut through them, exhibiting distant points of landscape, while charming promenades can invite the wanderer to seek cooling shades. Nature has been so rich in her vegetable creation that the plan of transplanting trees of large growth, which has been adopted in most of the modern parks, will be unnecessary. There are some few country seats, such as Blagden's, Pearce's, and Walbridge's, which have been highly cultivated; should it be found desirable to erect the presidential mansion within the enclosure of the park, the first mentioned site possesses many advantages, both ornamental and valuable. Here and there some prominent point offers commanding views of the surrounding country, where observatories can be located, conservatories built for exotic plants, and geometrical flower-gardens planted. Back from the stream some level plateaus extend, which can be appropriately employed for zoological and botanical gardens, grounds for play and parade, and many other useful purposes.

The map shows the most desirable localities, the surveys having been made in great detail. The lay of the land is such that it admits of thorough drainage, and the nature of the soil offers all the facilities for building good roads; the granite and limestone rocks which are found outcropping at different points will furnish the materials for their superstructure, In fact, every facility is offered for laying out and constructing a grand national park.

The questions now arise as to what should be the extent of the proposed work, and the probable price of the land. As it should be one worthy the capital of the nation, and as the ground can be secured at a reasonable price before being occupied by costly suburban villas, it is respectfully recommended to the honorable committee to purchase at once a sufficient number of acres bordering on Rock creek to anticipate the future growth of the city and its increased population. With the view of retaining as much of the picturesque scenery along the stream, and of also embracing the sites of some few of the forts on the north constructed for defence of the city, which have become historical, and from the parapets of which extensive views can be had, I have marked on the maps such lines as may be satisfactorily taken as approximate bounds of the park. In case my recommendations should be considered too extravagant, I have caused a second series of lines to be drawn for grounds of more moderate dimensions. The first tract would contain about two thousand five hundred and forty acres, more or less; and the second, one thousand eight hundred, more or less. As there is so much difference of opinion as to the price of the land, the quality and improvements varying so much, it is a difficult matter to offer anything more than an approximate appraisement. As the right of eminent domain empowers the government to take property, and as such power is the necessary incident to sovereignty, the question would finally have to be settled by a commission appointed by some competent court. The price ranges from $50 to $1,000 per acre; a mean of $200 should amply cover the entire cost. It will be noticed that the southern limits, as drawn, of the proposed park, do not approach more closely than necessary the city limits, leaving out where possible such sites as would greatly enhance the cost. Avenues leading along Rock creek to the southern limits of the park should be opened. According to the above figures the larger tract would amount to $508,000, and the smaller one to $360,000. As the work of constructing a park will consume many years, no longer delay than is absolutely necessary should be consumed in the preliminary arrangements for the passage of the necessary laws and the purchase of the lands.

The dimensions of the most celebrated European parks are as follows:

London.—All parks in and near London, including gardens, squares, and parade grounds, 6,000 acres. Hyde Park, 380 acres; Regent's Park, 372 acres; Windsor Little Park, 300 acres; Kensington, 227 acres; Windsor Great Park, 3,500 acres; Richmond Park, 2,250 acres.

Dublin.—Phœnix Park, about 2,000 acres.

Garden at Versailles, 3,000 acres; Bois de Boulogne, 2,158 acres; Munich, Englischer Garten, about 500 acres; Vienna, Prater, 1,500 acres; Birkenhead Park, near Liverpool, 180 acres.

The Central Park of New York, the most important work of the kind undertaken in America, is over two and a half miles in length by one-half mile in breadth, and contains over eight hundred and forty acres. There are about nine and a half miles of drives, five and a half miles of bridle road, and some twenty-five miles of walks. The annual sum provided for the expense of maintaining it, to wit, $150,000, is reported to be insufficient. The number of visitors continue to increase with each year; in 1865, 7,593,139 persons entered. Hunting Course Park, near Philadelphia, and the Druid Park, near Baltimore, have also been constructed. The establishment of parks is exciting great attention throughout the land, and adds vastly to the enjoyment of the people.

I would now call the attention of your honorable committee to the remaining subject of this report—the selection of a site for a presidential mansion. In the memoranda submitted to the Secretary of War by letter of July 26, 1866, you requested "that the ground known as Meridian Hill," and "the estate of the late Washington Berry," should be particularly examined, as they are thought to contain all the requisite advantages for such a site; "also such other localities as may, in the judgment of the engineer," present eligible positions for such a purpose. In compliance with your wish, I made special reconnaissances and surveys of the above-named places, as well as some others, which offer great inducements, and will now discuss each separately.

I. *Meridian Hill*—(Colonel Messmore's estate.)—This site is located due north from the present White House, on the first range of hills bounding the limits of the city of Washington. It is of easy access, several avenues and streets leading in that direction. On the east it adjoins the lands of Columbia College, and on the west those of Mr. Little. The number of acres contained in this tract is one hundred and twenty, which added to that of Mr. Little's thirty-eight acres gives a total of one hundred and fifty-eight. The latter offered to sell to the government at about six cents a square foot, or $2,613 per acre. On both these estates are eligible building sites; the view towards the south, overlooking the city and the valley of the Potomac, being particularly fine. At one time some large forest trees added beauty to the scene, but most of them were destroyed during the war. There are no improvements, the old mansion-house having been destroyed by fire, and the walls are alone standing. North of the site the land is nearly level, only slightly undulating. Although possessed of considerable advantages, there are several objections to this selection, in connection with the object in view. Lying just above the plateau of the city, and not screened by any belt of timber, it is exposed to the miasmatic influences rising from the marshes of the Potomac. Again, it is too near the city to afford any retirement and repose for the Chief Magistrate. Already the street railroads approach, and numerous houses are being built on all sides of this site.

II. *Metropolis View*—(Homestead of the late Washington Berry.)—This estate lies northeast of the Capitol, between the old Bladensburg road and Lincoln avenue, the latter a continuation of North Capitol street. It is distant from the Capitol about two and a half miles, and from the White House about three miles. It contains some three hundred and fifty acres, valued by the trustees at $500 an acre, with the improvements, including a very fine spring; the whole is offered at $200,000. To the east of it lies Brentwood, the fine estate of Mrs.

Pearson, and to the west Glenwood Cemetery, and Harewood, the beautiful grounds of Mr. Corcoran. In front spreads out Eckington, so many years the homestead of the late Mr. Gales, which contains 130 acres; the price of this land is placed at $1,000 per acre, with $25,000 additional for improvements. Metropolis View is beautifully situated, having a high and commanding position; it is partially covered with groves of fine old trees, deciduous and evergreens, and possessed of an abundance of timber. A fine spring rises in the place, and two small streams, tributaries of the Tiber, course through it. In nearly every direction the eye meets with charming landscape scenes, and it overlooks the Capitol and the broad valley of the Potomac. This locality possesses many attractions, and is susceptible of great improvement. It is easy of access by some of the finest avenues and streets leading out of the city, and is at a very convenient distance from the most prominent public buildings.

Eckington is a delightful place, but it is not sufficiently high to afford any extensive views. It should, however, be purchased in addition to the Berry estate, should Metropolis View be selected as the site. The two tracts of land united would furnish ample grounds to surround the mansion, and also open a fine park to connect with the city on the direct line with the Capitol. The sum total of the valuations of both estates amounts to $355,000. In regard to the healthfulness of this locality, the opinions of those with whom I have consulted differ very materially. Some think that the miasma carried up the valley of the Tiber from the Eastern branch is very deleterious to health, while others, who have long inhabited these old homesteads, pronounce them to be perfectly salubrious.

III. *Harewood*—(Mr. Corcoran's estate.)—Among the many delightful drives around the city of Washington none can compare with those to be found within the enclosures of this delightful retreat. The grounds are most artistically arranged, and no expense has been spared in adorning them by all the appliances at the command of taste and wealth.

The grounds are naturally beautiful and undulating, and all that skill can accomplish has been applied to render them most charming and picturesque. In addition to the natural growth of vegetation, many trees and plants of other nations and climes have been introduced to impart their luxuriance to the scene. The estate covers some two hundred acres, but as you follow the gentle windings of the drives and walks, the imagination is led to believe it to be of much greater extent. Good roads lead to it from the city, making it perfectly accessible. A fine spring furnishes a plentiful supply of water, and in point of health it is all that can be desired. This spot, originally selected by the proprietor upon which to erect a princely mansion, is one of the most delightful situations among the many fine ones in the environs of Washington; it would be a most eligible site for a presidential mansion.

IV. *The homestead of Mr. Moncure Robinson.*—This estate is now occupied by a brother of the proprietor, the latter residing in the city of Philadelphia. It lies adjoining the lands belonging to the United States Military Asylum; the road which leads out of the city on the prolongation of North Capitol street and passes near the Home for the old soldiers, almost divides the place into equal parts. There are about seventy acres in all, which the owner proposes to sell at $1,000 per acre, without the improvements; these he values at $30,000. The mansion occupies one of the most elevated positions in the neighborhood of Washington. An extensive panorama of the surrounding country lies before the beholder; from every point of the compass the eye can dwell upon magnificent landscapes extending far into Maryland and Virginia, and combining all that is beautiful and picturesque. In one direction the gaze rests for miles on the waters of the majestic Potomac, and in another there are mountains and hills mantled with forests, and plains and valleys highly cultivated. The place contains a large portion of heavy timber, and is so situated as to offer numerous advantages for improvement. From its great height it will be far above all malarious influences. There are fine springs in the neighborhood, which furnish an abundance of water for useful and ornamental purposes. The locality is convenient to both cities. Through Washington several avenues and streets lead towards the road above referred to as connecting with North Capitol street; by this drive a straight-line communication can be had with the Capitol, the distance between the two being less than four miles. By the avenues and streets connecting with the Fourteenth street road and Seventh street turnpike, thence by Rock Creek Church road, a very direct drive of a little over four miles can be had with the White House and the public buildings adjoining it. From Georgetown almost an air-line can be had *via* Broundary street, Taylor's lane, and Rock Creek Church road, distance of about four miles.

Directly in front, or south of Mr. Robinson's beautiful locality, lie the very pretty grounds of Mrs. R. S. Wood, consisting of forty acres. The two must be considered inseparable should the Robinson site be selected for a presidential mansion. They are valued at about $1,000 per acre, not including the improvements. The two places can probably be purchased for $150,000. Mrs. Wood's tract joins Harewood on the south, and on the west that of the Military Asylum. The lands of the latter do not belong to the government, but are in trust for the old soldiers, and contain some two hundred and fifty-eight acres. A reference to the map will show the honorable committee the peculiarly attractive features, both of position and general convenience of access, offered by the locality described above, containing in all about one hundred and fourteen acres, sufficient for the necessary purposes of embellishment and utility; and lying contiguous to the already ornamented grounds of Harewood and the Military Asylum, enjoying all the charms and advantages of those delightful places, it would be difficult indeed to find a spot more admirably adapted as a retired, pleasant home for the President of the United States.

A table of distances from the Capitol and Executive Mansion to prominent points of interest is also added for the information of the committee.

Table of distances.

	From Capitol.	From Executive Mansion.
	Miles.	*Miles.*
To Mrs. Hobbie's, (southern limit of proposed park)	3½	2
Residences of General Walbridge and Mr. Brown	3¾	3
Pierce's mill	4¾	4
Residence of Mr. Blagden	4¼	3¾
Fort Stevens, (northern limit of proposed park)	5¼	5¼
Meridian Hill	3	1½
Metropolis View	2½	3
Residence of Mr. Robinson	3¾	4
Residence of Mrs. Wood	3½	3¾
Entrance to Harewood	3	3¼
Entrance to Old Soldiers' Home	4	3½

In concluding this report I would respectfully suggest to your honorable committee the necessity of commencing the construction of the national park as soon as practicable. It is a grand and beautiful undertaking, and should be prosecuted with the greatest energy. A sufficient appropriation for enclosing the grounds purchased, for improving and keeping in repair the drives and walks already constructed, and for the laying out of others, should be made. For this purpose one hundred thousand dollars would be sufficient for present expenditures.

I am, sir, very respectfully, your obedient servant,

N. MICHLER,
Major of Engineers, Brevet Brigadier General U. S. A.

Hon. B. GRATZ BROWN,
Chairman of the Committee on Public Buildings and Grounds, United States Senate.

Remarks on the vegetation of the District of Columbia, by Dr. Arthur Schott, of Georgetown; appended to the report of General N. Michler.

In order to specify the vegetable growth of the District of Columbia, in relation to the topographical features of the same, the subjoined lists of plants are suggestively proposed, as they principally tend to give shape to the general appearance of the landscape. As the geological aspect of the area in question presents considerable variety in its details, it is thought proper to bring the numerous floral types, not less varied in size, shape, and individual development, under separate heads, corresponding to their particular habits. For the sake of facilitating their survey, the various species are here arranged in the following order, commencing with the trees, larger and smaller, and these followed by shrubs, vines, creepers, and the undergrowth of herbs and weeds. The same disposition is observed in mentioning their topographical distribution, commencing on the hill tops, and then gradually descending to the low grounds, river banks, marshes, and bogs. As to the selection of the species hereafter named, there is no hesitation in giving the trees, shrubbery, and vines pretty much, in full, as all these forms by their size make themselves more prominent, while with plants, herbs, and weeds, either their rich floral, or more foliaceous development, or clustering mode of growth, invite special notice. Commencing with the more elevated portions of the District, particularly towards its western limits, the following are to be found:

White oak: Large, lofty; rich woods.
Post oak: Rough or post white oak; less tall; sandy soil.
Red oak: Good sized; rocky woods.
American beech: Large and very ornamental; rich woods on hill slopes bordering on water courses.
Hop hornbeam: Large and handsome; rich woods.
Mockernut hickory: Large and graceful; rich woods.
Shell-bark or shag-bark hickory: Tall, handsome; rich woods.
Thick shell-bark hickory: Good size, with the former.
Poplar tulip tree: One of the loftiest forms; rich woods.
Honey locust: Good sized, very ornamental; rich woods.
Spanish oak: Large or small; rich woods.
Quercitron or black oak: Large tree; dry woods.
Common persimmon: Middle sized, but handsome; sporadically all through.
Sassafras: Fifteen to fifty feet high; rich woods.
Red mulberry: Middle sized; rich woods.
Red bird: Small tree; hill slopes.
Tupelo, black or sour gum tree: Middle sized; hill-sides.
Locust tree: Tall, ornamental; borders of woods, hill and road sides.
Staghorn sumac: Twenty to thirty feet high; open hill-sides.
Smooth sumac: Of lesser size, on rocky, barren soil.
Box elder: Small, handsome tree; hill-sides; borders of thickets descending to river banks.
Flowering dogwood: Small tree; in rocky places.

Jersey or scrub pine: Fifteen to twenty-five feet high; on barren and sterile hills.

Red cedar: Fifteen to thirty feet high; dry, rocky, or sterile hill-sides.

Japan paper mulberry: Small tree or shrub; open hill and road-side; pretty well naturalized.

Panicled dogwood: Thickets and hill-sides; shrub four to eight feet high.

Black haw, shoe-leaved arrow-wood: Treelike shrub; shady hill-sides.

Maple-leaved arrow-wood: Three to five feet high; rocky woods.

Spice bush: Five to ten feet high; damp woods.

Poison oak; poison ivy: Climbing or trailing everywhere.

Bladdernut: Ten feet high; moist thickets.

Burning bush: Sporadically everywhere through the woods; tall and upright shrub.

Summer grape: Thickets.

Virginia creeper: One of the chinquopin; six to twenty feet high; sandy woods; boldest climbers; in the woods generally.

Maryland andromeda: Sandy woods; very ornamental.

Deerberry, squaw huckleberry: Dry woods and hill-sides; neat and graceful shrub.

Common swamp blueberry: Four to five feet high; moist, shady places and copses.

Purple Pinxter flower: All through the woods.

Indian hemp: Three to five feet high; valleys and hill-sides.

Woodbine: Trailing; rocky woods.

Trumpet honeysuckle: Woodlands.

Of the undergrowth, herbage, and weeds, the following may be mentioned:

Creeping wintergreen: Damp woods, in the shade of evergreens.

Ground laurels: Sandy woods and rocky soil.

Common greenbrier: Moist thickets.

Halbert-leaved greenbrier: Thickets in sterile or sandy soil.

Bouncing bet, common soapwort: Thoroughly naturalized, in waste places, and rugged, open hill-sides.

Wild pink: Rocky or gravelly places.

Purslane: Sunny sites in rocky or sandy soil.

Spring beauty: Moist, open woods.

Velvet-leaf: Escaped from gardens, naturalized in waste places.

High mallow: Naturalized like the former; waste places.

Wild crane's bill: Open woods.

Wood sorrel: Three species; rocky places.

Wax-work, climbing bittersweet: Along streams and thickets.

New Jersey tea: Undershrub; dry woodlands.

Milkwort: Woods, in light soil; besides three or four more species of the genus.

Meadowsweet: Two or three species, among them F. tomentosa, L. hard-track, steeplebush; low grounds and meadows.

Indian physic: Also called bowman's root; rich woods.

Purple flowering raspberry: Ornamental; hill-sides and rocky banks.

High blackberry: Border of thickets.

Running swamp blackberry: Wet woods.

Sand blackberry: Sandy woods.

Hawthorn; whitethorn: Dry rocky banks.

Shadbush; serviceberry: Hillsides and river banks.

Deer grass; meadow beauty: Sandy swamps.

Loosestrife: Wet meadows.

Common evening primrose: Everywhere.

River sundrops: River banks and swamps.

False loosestrife; seedbox: Swamps.

Yellow passion flower: Damp thickets.

Early saxifrage : Exposed rocks.
Bishop's cap : Hillsides, in rich soil.
Panicled cornel, four feet to eight feet high : Thickets and hillsides.
Bluets ; delicate little herb : Grassy banks and commons.

Of the very large family of compositæ, especially fully represented in North America, the District has its correspondingly good share. The species are distributed over every kind of locality, but to mention them all separately would lead too far ; it is therefore preferred to present here an extract of such genera, which show the largest and most showy species. They are as follows :

Ironweed, button snakeroot, thoroughwort, mistflower, coltsfoot, starwort, double-blistered starwort, golden rod, golden aster, groundseltre, elecampane, rosin plant, oxeye, coneflower, sunflower, tickseed, burr marigold, crownbeard, cudweed, everlasting, Indian plantain, plumed thistle, hawkbit, hawkweed, rattlesnake root, &c., &c.

Cardinal flower : Low grounds.
Great lobelia : In similar localities.
False wintergreen : Damp sandy woods.
Small pyrola : Open woods.
One-sided pyrola : Rich woods.
Pipsissewa : Dry woods.
American cowslip : Rich soil.
Common mullein : Fields and roadsides.
Turtlehead ; snakehead : Damp thickets.
Bushy false foxglove : Dry copses.
Painted cup : Low grounds.

Of the mint family well represented in the District the following genera count the more showy forms ; Horsebalm, dittany, horsemint, sage, catmint, mountain mint, scullcap, false dragonhead, germander.

Of the borage family, the following genera are more prominently represented : Vipers bugloss, false cromwell, smooth lungwort.

Of the waterleaf family : Waterleaf.
Of the polemonium family : Phlox, several showy species.
Of the convolvulus family : Bracted bindweed, morning glory.
Of the nightshade family : Jamestown weed, thorn apple, nightshade.
Of the gentian family : American centaury, gentian, American columbo.
Of the milkweed family : Milkweed, gonolobus.
Of the birthwort family : Wild ginger.

The class of the endogens is equally well represented by members of the following genera : Adam and Eve, or putty-root, false orchis, Arethusa, ladies' tresses, rattlesnake plantain, lady's slipper, star grass, blue-eyed grass, yam, three-leaved nightshade, Solomon's seal, lily, dog's-tooth violet, bellwort, devil's bit. Of the remaining genera of this class, the following ought to be mentioned : Dayflower, spiderwort ; besides a very extensive list of grasses and sedges which close the series of endogens.

Especially noteworthy for the wood flora are of the cryptogams, the fern, and mosses. The former, of course, appear more prominent on account of size and higher development. The following genera are characteristics for the District : Polypody, brake, bracken, maiden hair, Woodwardia, spleenwort, Dicksonia, bladder fern, woodsin, wood fern, shield fern, sensitive fern, flowering fern, moonwort.

Of the clubmoss family, (lycopodium, the ground pine,) lycopodium dendroideum, Micht., and L. complanatum, L., are the more conspicuous.

The list of herbs and undergrowth plants in general has been given here more extensively on account of the broader distribution of the genera and species, which descend almost equally from the hill-sides over clearings and open flats, down to the water's edge. It now remains to name such species of trees, shrubs, and suffrubicose forms, not mentioned heretofore on account of their being more exclusively bound to the vicinity of water-courses, swamps, and bogs. The following deserve particular notice:

Swamp white oak: Pretty large; low, moist woods.
Swamp chestnut oak: Low woods and river banks; a large tree.
Willow oak: 30 to 50 feet high; sandy, low woods.
Black jack or barren oak: 8 to 20 feet high, dry, sandy barrens.
Sweet gum: Moist woods; large and beautiful tree.
Hornbeam, ironwood: 10 to 20 feet high; along streams.
River or red birch: Large tree; gracefully overhanging river banks.
Smooth alder: 6 to 12 feet high; bordering water-courses.
Silk-leaved willow: Shrub 4 to 10 feet high; sandy river banks.
Brittle willow: Tall and handsome.
Poplar, aspen: 20 to 50 feet high.
Large toothed aspen: Large tree.
Planetree, buttonwood; also called sycamore: Large tree, alluvial river banks.
Sweet bay, small or laurel magnolia: 4 to 15 feet high; swamps.
North American papaw: Small tree; bands of streams in rich soil.
Swamp rose mallow: 5 to 6 feet high; borders of marshes; flowers very showy.
Halbert-leaved mallow: River banks, swamps.
Maple, white or silver maple; Fine ornamental tree; river banks.
Red or swamp maple: Small tree; swamps and wet woods.
Strawberry bush: Wet places.
Winter or frost grape: Thickets and river banks.
Wild yellow plum: Bush or tree 8 to 15 feet high; river banks.
Chokecherry: Tall, overhanging shrub; river banks.
Swamp rose: Low grounds.
Witch hazel: Damp woods.
Common elder: Border of thickets and low grounds.
Buttonbush: Wet places; forming thickets.
Clammy or white honeysuckle: Swamps and boggy places.
Mountain laurel; also called cabin bush: Rocky hills, damp soil and banks of rivers.
Trumpet bower: Bold climber, with very showy flowers.
Leather or moose wood: Damp, rich wood swamps; 2 to 7 feet high.
American or white elm: Large ornamental tree; moist woods and alluvial river banks.
Fringe tree: Low tree or shrub, very ornamental; river banks.
Red ash: Woods along streams; large tree.

Most of the herbs and undergrowth plants of the lower sections of the District, such as swamps and overflows, will be found already embodied in the respective list above. Truly aquatic forms, though some of them peculiar to this locality, are not deemed necessary to be considered here.

As a general remark it may be stated that the western portion of the District, forming an outlier of the eastern slope of the Alleghanies, shows over its hillsides and valleys a far greater diversity of species than east, on the other hand, in the flats towards the Eastern Branch; these exhibit a tiring monotony on account of the more or less clustering habits of its vegetable forms.

In conclusion, attention may be drawn to the sudden changes in the qualities of soil, irrespective of the section it may belong to. For example, there can be observed on the top of a hill an excessive sterility, when on its slope, upon a horizon only a few yards below, the richest piece of ground imaginable may be encountered. The same occurs upon the flats and alluvions of the middle and eastern section. In most cases this will be found to be the result of the deteriorating agency of some kind of denudation, wherever the original vegetable cover of the soil had been impaired either by nature or man. Through the course of civilization in the immediate vicinity of a large city, the deteriorating causes by the hand of man are going on almost incessantly. It is therefore that we here find very extensive patches of land which, after having been cleared of their original cover, are deprived of every particle of vegetable soil; hence the multitude of desolate hillslopes and flats, alternating upon the same level with pieces of the richest forest lands imaginable. This observation may serve as subject for reflection in regard to inconsiderate clearing, and to the robbing of nature's treasures by a few seasons of speculative cultivation of the soil without ever making some just returns.

There is no doubt the surface crust of this District has been, previous to its disintegration, rich and genial. This is sufficiently proved by the above list of vegetable forms. After having been divested of its natural protection, denuding agencies, both natural and artificial, thoroughly impoverished it in many instances.

WASHINGTON, D. C., *January* 16, 1867.

A public park for the capital.

The following is the speech of Hon. B. Gratz Brown, of Missouri, delivered in the Senate on the 20th ultimo, on the bill for the establishment and maintenance of a public park in the District of Columbia:

Mr. BROWN. Mr. President, the bill which I have just called up is one to establish a public park in the vicinity of Washington city. It is reported from the committee as a substitute for a similar bill offered by myself at an early stage of the session, and differs from that chiefly in the modes designated for acquiring ownership of the designated grounds. The locality is the same, the general area contemplated the same, and the purpose of procuring and ornamenting such a public place of resort, at the expense of the United States and not of the corporations of this District, is the same.

It will be remembered, Mr. President, that at the last session of Congress, when this matter was first mooted, objection was taken to the lack of definite information on which to proceed in making selection of grounds; and to obviate that difficulty as far as possible, a resolution was referred to the Committee on Public Buildings and Grounds, of which I have the honor to be chairman, instructing them to have surveys made of various eligible sites around the city of Washington adapted to the purposes of a public park. In pursuance of that resolution of the Senate, an application was made to the Secretary of War, which secured a detail of engineer officers, who, during the recess of Congress, proceeded to make the surveys desired. I hold in my hand an elaborate map, containing the result of those surveys, accompanied by an admirable report from the officer in charge of the work, which report has been printed and laid on our tables. I have before me also a minor plat, illustrative of the surveys, which it may be well for senators to scrutinize. It was found, on making these examinations, that there was but one location in the neighborhood of this city eminently adapted to the purposes of a public park. I suppose all members of the Senate are familiar enough with the environs of the city to know the beautiful and romantic valleys of Rock creek. The character of the ground around and adjacent to that stream is exactly suited to the purposes we desire. It has running water; it has rugged hills; it has picturesque scenery; it has abundance of varied forest timber; it has a native undergrowth seething with beauty. It has the tangled vine and the clustering wild flower, and the quiet mosses, gray with age, and indeed a thousand imprints of native adornment that no hand of art could ever equal in its most imitative mood. Moreover, with so much of attractiveness in its present uncultured state, it has likewise every capacity for adornment and development, and can be made, with less expense than almost any spot of equal area I have ever seen within reach of a great city, one of the most beautiful resorts in the world. The amount of ground which was surveyed embraced twenty-seven hundred acres. It will not be necessary, however, to take in all of that ground in order to secure what is desired for the purposes of a park, in the shape of drives, alcoves, recesses, and places capable of adornment. Fortunately the amount to be embraced is almost entirely optional, as the situation is such that large additions may be made without abating much the extent of the drives or the beautiful diversity of views.

The committee, after having made a very careful examination of the plans and surveys submitted by Brigadier General Michler—and, by the way, I must be permitted here to compliment him in the highest terms for the zeal he has manifested in this work and the admirable manner of its execution—the committee, I say, finding that the number of owners was so great as to preclude any joint offer for sale to the United States, thought it best to establish a commission authorized to negotiate in behalf of the government, and subjecting their action to the approval of the next Congress. It was believed that if we were to order a condemnation of the ground there might be improper combinations to secure a verdict, and the interest of the government might be sacrificed in the premises. It was believed, furthermore, that if an opportunity was had for conferring authoritatively with those who owned the ground, and if it was known that the purchase would depend in a great measure upon the reasonable character of the offers that were presented, there would be an opportunity of getting what was needed at a fair price, and probably of making a better selection of that which was desired than by any other mode.

For this reason the committee have reported a bill which simply provides a commission, and that commission embraces the officers who have had charge so far of the surveys, together with General Meigs, who is placed at the head of it, and authorizes them to confer with the owners of the property, to see what terms can be had, what grounds may be held by minor heirs or others that it will be necessary to condemn, and to find what portions may be left out and still not impair the desirability of the grounds for the purposes of a public park, and report the whole of their investigations and all their propositions at as early a day as may be found practicable.

I do not think there is anything in the bill that can be objected to, if it is desirable to enter upon the work of securing for the city of Washington a public park. I think it is of such a character that will probably conduce more to the security of the government than any other which can be drawn. As to the necessity and the desirability of initiating such a proposition and obtaining the necessary location now, while the ground can be had on reasonable terms, I do not think there is much room for question. The ground in the vicinity of this city must soon become immensely valuable, now that the uncertainty with which sectional discord and disunion so long threatened the stability of the capital has passed away. At the present time Rock creek and its adjacent heights has few residences upon it, and those of comparatively trifling value, and the whole area surveyed can be had, as is estimated by General Michler in the report he has submitted, at an average price of perhaps less than $200 an acre. This would make a total cost of less than half a million dollars; a mere trifle of expenditure for "a thing of beauty" which will prove "a joy forever."

Mr. President, I had intended, when presenting this subject to the consideration of the Senate, to have remarked somewhat freely upon the influence such surroundings are calculated to exert upon those who come hither from all parts of this great nation to bend their minds to the dismal science of law-making and of government. Those who, for any length of time, have undergone the wear and tear of such life as this, who have all their energies run to brain, and all their souls fused into politics, need not be told that anything which holds out hope of either mental or passional relief is seized upon with avidity. How necessary, then, that all the ennobling influences of nature—the scenic splendor of shifting views, the life and animation of gay concourse, the uprisen majesty of the forest, the intoxicating gladness of spring flowers, the laugh of the heavens through playing branches, the shimmer of the waters, the song of birds, graceful forms, inspirations—should be so abundantly grouped around this nation's capital. There is no expenditure that can be made which shall add to the grandeur or adornment of the public buildings that fill so largely the eye of admiration of the world, or of the vast libraries that are accumulating so rapidly the treasures of all languages within your reach, or of the conservatories and gardens and cabinets that minister to your tastes, that will not freely be sanctioned by the people; for such in itself is the establishment of a nation's university, whither all may come to wonder and to learn, and in which all may feel a rightful patriotic pride. Only let it be worthy. Let your doing be on a scale commensurate with the pride to which you minister and the people you are sent hither to represent. And it is in the same spirit that I would have you, senators, inaugurate a public park that shall have no rival anywhere for beauty or extent or ornamentation, as it will have none for the illustrious characters gathered from a whole continent in the after time to wisely rule our republic from this centre of its power.

Mr. President, the experience of foreign nations has been worth much on this subject of the extent of their places of public resort, and I do not think it would be wise in us altogether to disregard it. There it has been found that size was an invaluable feature, and even in the present day continued effort is being made to enlarge those now in existence. The latest data I have been able to lay my hands upon gives the dimensions of the more celebrated European parks as follows: Hyde Park, 380 acres; Regent's Park, 372 acres; Windsor Little Park, 300 acres; Windsor Great Park, 3,500 acres; Richmond Park, 2,250 acres; Phœnix Park, at Dublin, 2,000 acres; Garden of Versailles, 3,000 acres; Bois de Bologne, 2,158 acres; Englitche Garten, at Munich, 500 acres; and the Prater, at Vienna, 1,500 acres. The Central Park, in New York city, contains 840 acres, and authority has just been granted for the laying out of a park at Chicago of 2,000 acres. It will thus be made to appear that the amount of territory embraced in the present survey, 2,700 acres, does not exceed many of the more famous of those I have cited. And yet what would be thought of the proposition to reduce the area of either Windsor Park or Phœnix Park, or the Garden at Versailles? It would be simply set down, sir, as a barbarism. Let us, then, profit by the accumulated experience of so many metropolitan cities and so many great nations, and secure, while we may, here at the city of Washington, ample scope for a national park worthy of our people and our country.

But I perceive it is unnecessary to prolong any speech in behalf of what the Senate is evidently so willing to concur in voting. I will close, therefore, with expressing the hope that no delays attendant upon the close of the session may cause this measure to fail in the other branch of Congress, and that if it shall become a law the commission organized under it will not be too contracted in their views as to the extent of ground that should be embraced in this national park.

APPENDIX T—2.

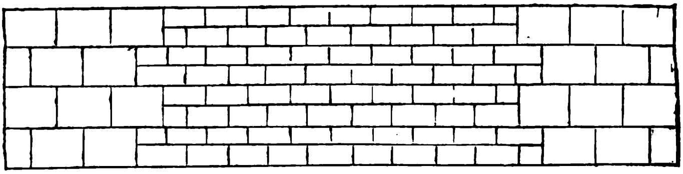
Copy of a letter from General M. C. Meigs, appended to the annual report, dated October 1, 1867, of Brevet Brigadier General N. Michler, in charge of public buildings, grounds, and works.

DRESDEN, *July* 27, 1867.

DEAR GENERAL: You are, I believe, now in charge of the paving of the avenues, for which appropriations have been made by Congress, and of the expenditure of the funds appropriated for the public places in Washington.

The streets of the cities of Germany, Denmark and Prussia, which I have lately seen, are so well paved that I am induced to send you a few notes thereon.

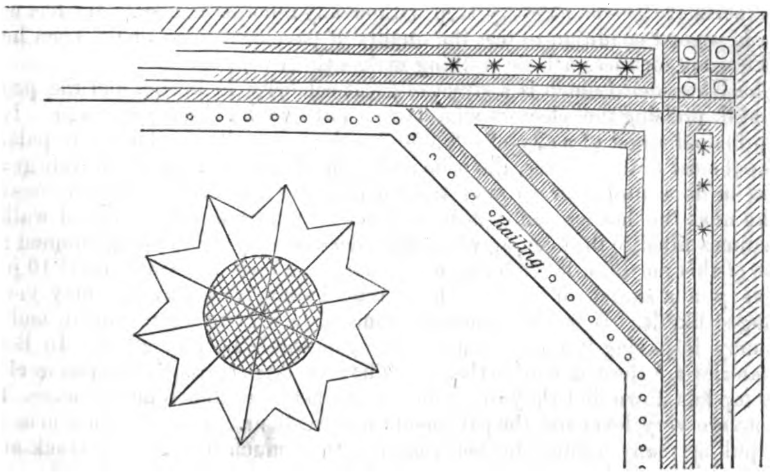
The pavement in general use is like what we call Belgian. The blocks used are not large, but they are laid in regular courses across the line of travel. I noticed that larger blocks are often used on the margin of carriage roads than in the more frequented middle of the way.



Care seems to be taken to lay the courses at right angles to the line of travel. In a few streets they are laid diagonally, but in only a few. The stones seem to be laid on a bed of gravel or coarse sand. In the repairs I have seen making I saw no other preparation as foundation, but I am not sure that in first paving a street some greater and more elaborate preparation is not made. The French Ponts et Chaussées reports will doubtless give full details.

Sidewalks here are never paved with brick. There is generally a line of flags admitting of walking in single file; in the wider and more important streets two such lines. The rest of the sidewalk is either paved as the street, sometimes worse, *i. e.*, with cobble-stones, which are torture to the feet, or else it is paved with small stones about the size used for concrete or macadamizing, which are laid in sand or gravel as close as they can be packed, points down and flat bases up, and then rammed to a smooth and even surface. These make a pavement easier to the foot than either flags or bricks, and as the stones are sorted and laid in patterns, far more pleasing to the eye than either. A space around every fountain or statue in the public places and streets of Berlin is paved with this mosaic. The colors used are red, gray, black, brown, which seem to be granites and sandstones, and white, which is of marble fragments.

In the pavement about the monument to Frederick the Great, the pieces of stone average two square inches surface each, or fifty of them fill a space of 10 by 10 inches. Below is one corner of this pavement:



Stars 10-rayed—white, with red centres. Color of pavement—red, gray, blue, white.

This pavement never gets muddy like our gravel walks. It dries after a shower quickly, even more quickly than brick, and far more rapidly than flag-stone.

A shower brings out the colors more vividly and improves its appearance. It is very pleasant to the foot and very ornamental to the street and squares.

Your resources in Washington are red and gray sandstone from the Seneca quarries, brown from the stone-yards, blue limestone veined with white from the Potomac, gray granite, red fragments of brick, white spauls from the marble yards of the city, and doubtless other colors would be found if the attempt to introduce this pavement around the Greenough's Washington, the Jackson, the Mills's Washington, the fountain at the Capitol, &c., was made.

Shop-keepers in Berlin lay the whole pavement in front of their shops in this rude and cheap mosaic, sometimes. The name of the store or the number is sometimes introduced in block letters—white or black. The experience of these old towns leads them to pave the whole of their public squares which are not parks. They are used as market places—tables or wagons standing all over them. They are paved as the streets—nearly level—with very shallow undulations serving to carry off the water to the gully holes of sewers passing under them. The streets, which come in irregularly, seem to continue their pavement across on the direct lines of travel. The intermediate spaces are paved in irregular lines, or laid off into circles, triangles, &c., in which sometimes stones sorted of different tints are used with good ornamental effect, and sometimes the decoration depends upon the coursing above the block.

The space in front of such buildings as the Capitol is, in Europe—as far as I have yet seen—always paved. The court-yards of palaces are also paved like streets; not with flags or regularly cut stones, but with rough rectangular blocks like those used in Belgian pavements, and with mosaic of the small two-inch stone like Berlin trottoirs.

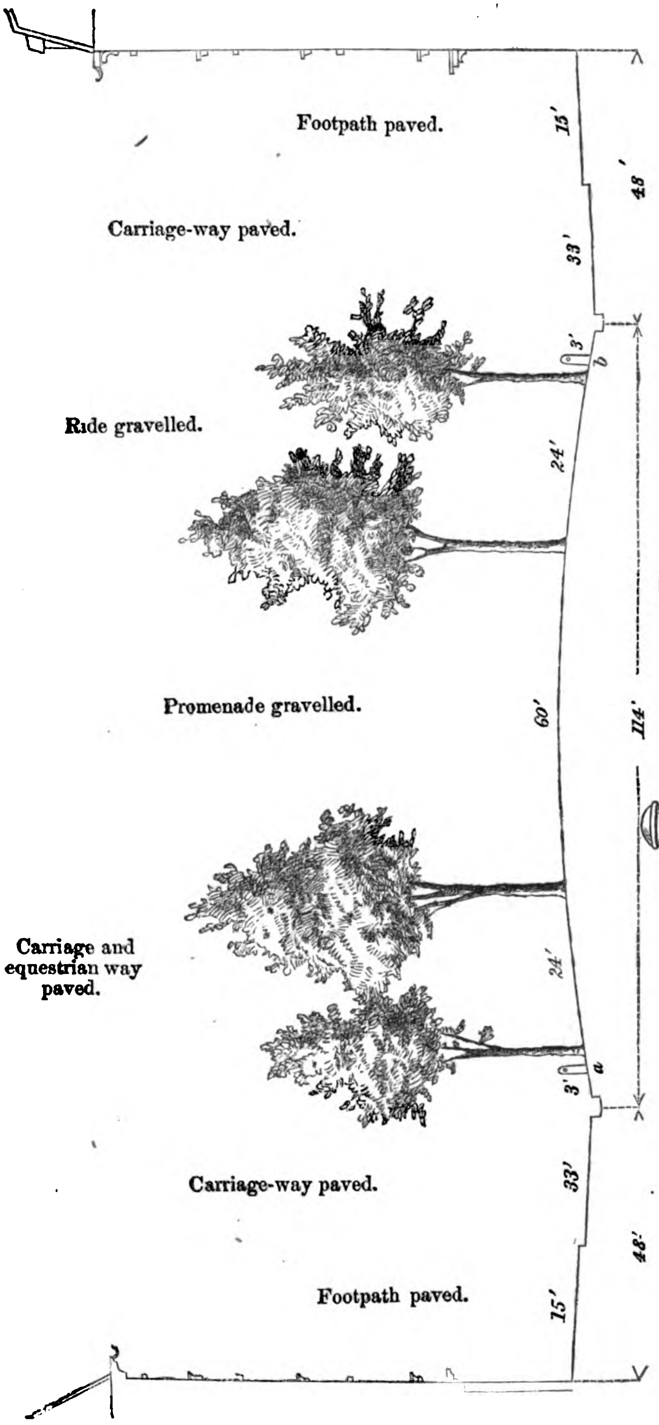
Rain and the broom keep all free from dust. The waste of gravel and sand east of the Capitol would be much improved by such a pavement; Belgian on all the lines much used by carriages—small mosaic on those parts used principally by footmen.

Asphalte is also much used for sidewalks in the German cities, as in Paris. With us it is too expensive, and I do not find it as pleasant to the foot as the small stone mosaic pavement, whose irregularity is sufficient to prevent the soreness caused by treading always upon a flat, hard stone surface, which presses the same parts of the sole at every step without any relief or change. My feet have been in a good condition to test the quality of pavement since I have been here, for since my sickness a little walking makes them very sore.

The Unter-den-Linden is a street of great celebrity in Berlin, and the people are still praising the electors who laid it out two hundred years ago. It is the principal street of a city of 600,000 people; upon it are the royal palaces, those of most of the princes, the principal shops and hotels. It has a wide gravel walk in its centre, four rows of trees which give shade, wide trottoirs or sidewalks next the houses, and yet it is never encumbered. The central walk is sometimes filled in the evening with promenaders enjoying the long summer twilight of this northern latitude, in which darkness does not come until 10 p. m. I give you a sketch of it, and I hope that Pennsylvania avenue may yet be arranged like it. It would, in our hot climate, be a great improvement, and the economy in paving it and keeping it in repair would be very great. In Berlin droschkies are the common carriages. They are large carriages, to open or close. The top lets down and they carry four to six persons, all behind one horse. The streets are very level and the pavements are excellent. I have seen a man and dog pulling many a four-wheeled wagon with as much furniture or truck on it as a good horse and cart draw with us. Dogs are in universal use by the street porters in place of horses—generally only one dog harnessed along a pole. The man or boy takes hold of the pole and pulls by a "bricole" over gutters; the dog does the whole work in smooth places.

But to the Unter-den-Linden, whose trees are not very large. They have, I suppose, perished in occupations of the city by hostile armies and been repeatedly renewed.

SECTION ACROSS "UNTER-DEN-LINDEN," BERLIN.



a and *b* represent lines of stone posts about 15 feet apart, connected by iron rods about 1¼ inch.

If the thirty-three feet carriage way happens to be full or obstructed, carriages take the twenty-four feet line between the trees, but these twenty-four feet lines are ordinarily used only by equestrians and by porters, who drag their wagons, assisted by their dogs. One of them, that on the north side of the promenade, is gravelled to be used as a summer road.

This street is the resort for business and recreation of all Berlin, and of all strangers.

Pennsylvania avenue is capable of a similar improvement. You see ninety feet are given exclusively to footmen, sixty-six feet to carriages, forty-eight feet are common property of footmen, horsemen, and carriages.

Hoping that these details will interest you, and serve, perhaps, as authority in introducing improvements as yet novel in Washington,

I am, with regards to our friends at the club, yours truly,

M. C. MEIGS.

General MICHLER, *Washington, D. C.*

A true copy:

N. MICHLER,
Major of Engineers, Bvt. Brig. Gen. U. S. A.

APPENDIX T—3.

Report of the engineer of the Washington aqueduct, appended to the annual report, dated October 1, 1867, *of Brevet Brigadier General N. Michler, in charge of public buildings, grounds, and works.*

OFFICE OF THE WASHINGTON AQUEDUCT,
Washington, D. C., October 1, 1867.

GENERAL: I have the honor to submit the annual report of the operations upon the Washington aqueduct during the past year, and an estimate of the amount required for its completion.

POTOMAC DAM.

At the date of the last annual report, October 1, 1866, work had been resumed on the Potomac dam at Great Falls, and it was confidently predicted that by the beginning of December the foundation masonry would be completed across the Maryland channel to Conn's island. A heavy freshet occurring on the 16th of October caused high water for the remainder of the season and a suspension of work upon the foundation masonry. The superstructure masonry was continued until December 20, when all operations were suspended for the winter.

This year the spring freshets were unusually high, accompanied by large masses of ice. Although the dam was unfinished, the masonry sustained very little damage. The water did not subside sufficiently until the 20th of June, when a large force of masons and laborers resumed operations, and although the season has been unusually wet and the work often interrupted by freshets, yet, owing to the energy and perseverance of the contractors, Messrs. Charles H. Sherrill and Anson Bangs, the foundation and superstructure masonry are now completed across the Maryland channel to Conn's island. A large portion of the temporary dam was washed away during the spring freshets, and several times during the summer. It was repaired after each freshet, and kept in repair until the present time.

GATEHOUSE AT GREAT FALLS.

The work on this gatehouse has been resumed, and it will be completed before he beginning of winter. The floor and the timbers supporting the iron gates are very much decayed, and should be replaced with flooring and girders of cast-iron.

BRIDGES.

The stone bridges on the aqueduct are all unfinished. An estimate of the cost of completing them will be found at the end of this report, and also in each of the annual reports for the years 1864, 1865, and 1866.

The importance of completing these bridges cannot be overestimated. In their present state they are rapidly deteriorating, and if we have a succession of winters as cold and changeable as the last, their usefulness for aqueduct purposes will soon become seriously impaired.

CONNECTING CONDUIT AT THE RECEIVING RESERVOIR.

The work on the connecting conduit was resumed August 13, 1866, and vigorously prosecuted until its completion. Dalecarlia tunnel, eight hundred feet in length, was continued day and night until March 4th, when it was pierced through. On August 8th the waters of Powder Mill Branch and of the receiving reservoir were shut off, and the water of the Potomac (which since the 5th of December, 1863, had emptied into the receiving reservoir) was turned into the new connecting conduit.

In making the excavations for this conduit, more rock was encountered than was estimated for; nearly its entire length was built on rock foundations, but the most expensive and difficult portion of the work was Dalecarlia tunnel, a large part of which is constructed through soft and loose rock that is not self-sustaining. This part of the tunnel, as it progressed, was carefully shored with heavy timbers and every precaution used to protect the lives of the miners and to prevent the roof and sides from caving, yet extensive slides took place and several accidents happened to the workmen, though only one life was lost. Over one hundred feet of the south heading caved in and became an open cutting.

The cost of the connecting conduit has consequently exceeded the appropriation made by Congress in July, 1866, and there is a balance due the contractors, Messrs. Sherrill and Bangs.

Three hundred feet of the tunnel will have to be arched, and the water slopes of the embankment will have to be lined with ripraps to protect them from the waves of the receiving reservoir.

THE RECEIVING RESERVOIR.

On August 8th, when the Potomac water was turned into the connecting conduit, this reservoir was shut off from the conduit and has not been used since. The water in it, which had become very impure, was emptied out; it was refilled again and now contains about four days' supply, which can be used in the event of an accident happening to the conduit above.

This reservoir could be improved and made very useful for storage and settling of water, by deepening the shallow parts and lining the slopes with ripraps. Eventually this improvement will be found necessary. The lands in connection with this reservoir might be improved and beautified, and made into a park which would be easy of access and a desirable place of resort.

DISTRIBUTING RESERVOIR.

Work on the distributing reservoir was suspended in June, 1864. Since then it has been used for storage and settling purposes. On the completion of the connecting conduit, the Potomac water was introduced directly into this reservoir. Owing to its unfinished condition it is necessary to keep the water at a low elevation. When it is finished the water can be raised several feet higher, which will give a greater pressure in the pipes and a largely increased supply of water to Capitol Hill, and other high points in the cities.

This reservoir has been in use for over three years and no repairs have been made on any part of it. The estimate for completing it is, consequently, considerably increased, and the longer it is used in its present state the greater must be the final cost of completing it.

In the estimate I have included the cost of laying an iron main from the distributing reservoir pipe vault to Foundry branch pipe vault, to be used either for a supply or drain pipe. If, from any cause, it becomes necessary to empty this reservoir, it can be done only by shutting off one of the mains and using it for a drain pipe. The necessity of having separate drainage and supply pipes is sufficiently obvious. The several gate-houses in connection with this reservoir are in an incomplete condition, and during the cold weather of last winter were a constant source of expense and anxiety, and a watchman had to be employed, day and night, to keep the water in them from freezing over.

HIGH SERVICE RESERVOIR AT GEORGETOWN.

The high service reservoir is also unfinished, but has been in constant use since June, 1865. Its present appearance is very unsightly; either it should be finished according to the original design, or the dome should be cut down to the level of the gravel walk and protected by an ornamental iron railing.

WATER-PRESSURE ENGINE.

The Worthington water-pressure engine is located in the west abutment of bridge No. 6. It has supplied the high service with water for nearly eight years. It was first put in operation in November, 1859, and worked till October 20, 1862, when it was stopped for repairs. The pistons were taken out and sent to New York, where new cylinders were cast and fitted to them, and the engine was put in motion November 11, 1862. It was stopped again for repairs in August, 1863, and the valves, which had become worn, were taken out and planed. Since then it has been stopped but a few hours at a time for slight repairs until the 16th of last month, when it was taken apart and fitted with new pistons and completely cleaned and repaired. This occupied seven days, and the heights were supplied with water by the Georgetown steam fire-engine, which was loaned by the city government for that purpose. The water-pressure engine is now as good as new, and is again in constant operation.

IRON BRIDGES.

Bridge No. 5 over College pond is in good condition.

Bridge No. 6 over Rock creek is now being repaired. The forty-eight inch tubes have been thoroughly scraped and painted; the ornamental wreaths which encircle the joints of the tubes had become loose, and many of them dropped off; several fell into Rock creek and cannot be found; the others, and those which were loose and liable to fall, have been replaced and securely bolted to the tubes. The sidewalks are nearly worn out, and the roadway requires a new floor to bring it even with the rails of the Washington and Georgetown railway.

GOVERNMENT MAINS.

The government mains are all in good condition. The twelve-inch main in Pennsylvania avenue between Sixth and Eighth streets east was lowered three feet during the past summer, in order to conform to the grade of the avenue; and a twelve-inch stop valve was placed in the main near Sixth street east. In North B street a twenty-inch main is now being laid, and will be connected by a twelve-inch main with the pipes in the Capitol. This will increase the supply of water to the Capitol, but it will not be abundant until the distributing reservoir is completed, and the water raised to a higher elevation.

LANDS.

The United States occupy for aqueduct purposes the following described parcels of land:

At bridge 6, Georgetown, the lot on which are located the pipe yard, work shop, and office.

At the high service reservoir, a lot fronting on High street, and partly covered by the reservoir embankment.

In Montgomery county, the roadway across the farm of William Brooke, and near Great Falls the roadway across the farms of Jackson, Collins, and Anderson.

At Great Falls $5\frac{44}{100}$ acres of the estate of the late Hall Neilson.

Each of the above described pieces will always be required for aqueduct use, and as the United States do not own them, I respectfully recommend that they be purchased.

FINANCIAL STATEMENT.

At the date of the last annual report the balance in the treasury applicable to this work was	$117,198 04
Appropriated by Congress December 20, 1866	12,000 00
Appropriated by Congress March 2, 1867	20,000 00
Total	149,198 04

The expenditures to date are as follows:

For construction of connecting conduit	$69,248 86
For construction of Potomac dam	33,057 90
For engineering, superintendence, and repairs	21,208 14
For office rent	187 50
For gas and fuel	188 85
For stationery	96 25
For rent of land	215 51
For printing and advertising	128 25
For internal revenue	204 97
For paving approaches to bridge No. 6	817 25
For repairs to water-pressure engine	300 00
Balance in treasury October 1, 1867	23,544 56
Total	149,198 04

Summary of appropriations made by Congress for the Washington aqueduct:

For April 30, 1852	$5,000 00
For March 3, 1853	100,000 00
For March 3, 1855	250,000 00
For August 18, 1856	250,000 00
For March 3, 1857	1,000,000 00
For June 12, 1858	800,000 00
For June 25, 1860	500,000 00
For July 4, 1864	150,000 00
For July 28, 1866	142,584 00
For December 20, 1866	12,000 00
For March 2, 1867	20,000 00
Total	3,229,584 00

ESTIMATE OF THE COST OF COMPLETING THE WASHINGTON AQUEDUCT.

For rent and purchase of $5\frac{44}{100}$ acres of land at Great Falls...	$1,320 00
For purchase of roadway from Great Falls to conduit, $2\frac{3}{10}$ miles, =18.4 acres..............................	1,012 00
For purchase of roadway across land owned by Wm. Brooke..	550 00
For rent and purchase of land at high service reservoir......	3,300 00
For rent and purchase of land at bridge No. 6................	2,640 00
For excavating rocks, trees, and bushes above dam at Great Falls..............................	5,500 00
For lining and repairing tunnel No. 1......................	1,650 00
For completing stone bridges..............................	27,500 00
For increasing embankment over conduit and macadamizing roads..............................	11,000 00
For lining 350 feet of connecting conduit tunnel............	15,400 00
For riprapping water-face of connecting conduit embankment..	11,000 00
For excavating the bottom of distributing reservoir to an additional depth of 13 feet and lining the interior slopes with rubble masonry laid in cement..............................	411,115 00
For completing gate-houses at distributing reservoir..........	44,538 00
For completing high service reservoir......................	8,800 00
For ventilators over conduit..............................	3,080 00
For fencing conduit and reservoirs..........................	22,000 00
For 30-inch pipe from distributing reservoir pipe vault to Foundry branch pipe vault..............................	78,633 00
For building office at bridge No. 6........................	3,300 00
For deficiency for the year ending June 30, 1868............	27,500 00
For engineering, superintendence, and repairs for the year ending June 30, 1869..............................	33,000 00
Total..............................	712,838 00
If to the above be added the amount of former appropriations..	3,229,584 00
The total will be..............................	3,942,422 00

Which amount will represent the total cost of the Washington aqueduct when fully completed.

I am, general, very respectfully, your obedient servant,

THEODORE B. SAMO,
Chief Engineer.

Brevet Brigadier General N. MICHLER,
Major of Engineers United States Army.

APPENDIX U.

Annual report on the survey of the north and northwest lakes for the year ending June 30, 1867, *Brevet Brigadier General W. F. Raynolds, lieutenant colonel of engineers, superintendent.*

OFFICE U. S. LAKE SURVEY,
Detroit, October 8, 1867.

SIR: At the commencement of the year ending the 30th of June last the lake survey parties in the field were prosecuting their several duties in the localities specified in my last annual report, as follows:

One steamer and two shore parties in Lake Michigan; two steamers and three shore parties in Lake Superior. Astronomical party divided into three sections, working in both Lake Superior and Lake Michigan.

The duties of these several parties will be reported upon separately.

LAKE MICHIGAN.

The surveys of former years in this important lake had been prosecuted with special reference to producing charts of localities, of which the following had been published:

The Straits of Mackinac, the Beaver Island group, the Fox and Manitou Island group, including Grand and Little Traverse bays. And the survey of Green bay had been finished, and charts of the same were in preparation, when it was decided to bring out a connected chart of the whole of the north end of the lake on a small scale, which, in connection with the published chart of Lake Huron, would cover a continuous district from the head of the St. Clair river, through the straits of Mackinac, and southward in Lake Michigan, past all the islands and known prominent dangers.

This decision rendered it necessary to extend the survey of both shores of the lake to the southward, including the off-shore hydrography in connection therewith; to carry soundings across the lake, and, as a triangulation was impossible, to connect the shore line by long azimuth lines and astronomical observations.

These important duties were divided as follows:

The astronomical party under charge of First Lieutenant M. R. Brown, corps of engineers, with divisions under assistants O. B. Wheeler and S. W. Robinson.

A hydrographical and primary triangulation party under Assistant O. N. Chaffee, on board the lake survey steamer Ada.

A topographical and hydrographical party on the east shore of the lake under Assistant A. F. Chaffee.

A topographical and hydrographical party on the west shore of the lake, under charge of Assistant Henry Gillman.

The astronomical party was first sent into Lake Superior, and was not transferred to Lake Michigan until the 27th of September. The instructions given were to occupy prominent points on both shores of the lake, south of the limits of triangulation as far as the shore line could be surveyed, determining carefully the latitude of as many prominent headlands as possible.

Eight points were occupied, two of which were on the east and six on the west shore.

Before these observations were computed Lieutenant Brown was relieved from duty on the lake survey, and First Lieutenant James F. Gregory was placed in charge of this work, the details of which will be found in Lieutenant Gregory's report, herewith attached, marked A.

Assistant O. N. Chaffee was instructed to continue the triangulation as far south as practicable; then to determine carefully the azimuths between headlands as far south on both sides of the lake as the shore line could be surveyed during the season; also to execute the off-shore hydrography of the northern portion of the lake. * * * * * * *

The method of checking the work by fixing the latitudes of points, and the azimuths of the lines connecting them, was adopted as the best that was attainable under the circumstances.

There being no points of sufficient elevation on the shore to command the distance across the lake, (which at the narrowest part is about sixty miles,) and the comparatively flat country and dense forests rendering a triangulation inland extremely difficult, if not impossible, and the direction of the shore lines being nearly north and south, the difference of latitude between points with the azimuth of the line connecting them gives a closer approximation to the distance than could otherwise be obtained. * * * * *

The off-shore hydrography was continued in the usual manner, south of previous work, for an average width of ten miles; on the east shore, from a point abreast of Point Aux Becs Scies (Old Point Betsey, as known by sailors) light-house, to Little Point au Sable, a distance of 78 miles; and on the west shore from near Bailey's harbor to Deansville, a distance of 48 miles.

This party returned to Detroit on the first of November, having accomplished the following details of work, viz:

Number of secondary triangulation stations	18
Number of sextant angles	380
Number of theodolite pointings	1,669
Number of theodolite readings	2,728
Number of lines of soundings run with steamer	111
Number of miles of soundings run with steamer	1,203
Number of square miles of off-shore hydrography	1,008
Number of miles of shore line run in connecting stations, &c., with shore work	2½
Number of readings of levelling rod	72
Number of casts of lead from steamer	1,070
Number of miles run by steamer on general duty	4,728

Five lines, separated from each other about nine miles, were sounded across the lake. The greatest depth of water found was 141 fathoms.

During the winter this work was plotted upon a scale of one sixty-thousandth, covering three sheets of antiquarian paper, with an area of 1,206 square inches of hydrography, and one sheet on a scale of one two-hundred-thousandth, covering an area of 473 square inches of hydrography.

Assistant Henry Gillman with his party sailed May 25, and was landed at White Fish bay, on the west side of Lake Michigan.

He was instructed to take up the survey on that side of the lake at the most southern point reached by previous surveys, which was near Bailey's harbor, and continue the work, embracing the coast line with the adjacent hydrography and topography, as far south as possible.

At the close of the season the survey of this coast had been completed to a point about two miles south of Two rivers.

The amount of work accomplished by this party was as follows:

Number of secondary triangulation stations built	10
Number of sounding stations built	134
Number of buoys placed and located	155
Number of sextant angles	68
Number of theodolite pointings	4,131
Number of theodolite readings	6,177
Number of compass readings for magnetic declination	659
Number of lines sounded with small boats	1,050

Number of miles sounded with small boats	1, 050
Number of casts of lead from small boats	47, 645
Number of square miles of hydrography, in shore	65
Number of square miles of topography	58
Number of miles run with stadia for topography	66¼
Number of shore lines run	73½
Number of observations on Polaris for determining meridian	8

During the winter the above was plotted on a scale of one sixteen-thousandth, requiring five antiquarian sheets and covering 759 square inches of topography and 944 square inches of hydrography.

Assistant A. F. Chaffee sailed with his party on the 19th of May for Frankfort, on the east side of Lake Michigan, with orders to commence work at Point Aux Becs Scies, where previous surveys ended, and work to the southward, if possible, as far as Little Point au Sable.

Assistant Chaffee returned to Detroit on the 5th of November, having finished the duty assigned him.

The following are the details of the work accomplished by this party:

Number of primary triangulation stations built	1
Number of sounding stations built	222
Number of buoys placed and located	164
Number of theodolite pointings	4, 822
Number of theodolite readings	4, 818
Number of compass bearings for magnetic declinations	43
Number of lines sounded with small boats	1, 310
Number of miles sounded with small boats	959
Number of casts of the lead from small boats	47, 428
Number of square miles of hydrography, in-shore	65
Number miles run with stadia for topography	71
Number of miles of shore line run	99
Number of level of sights taken	56

The above was plotted on a scale of one sixteen-thousandth, and covered seven sheets of antiquarian paper, including 941 square inches of hydrography and 375 square inches of topography.

The following is the total amount of work executed in Lake Michigan during the season of 1866:

Number of primary triangulation stations built	1
Number of secondary triangulation stations built	28
Number of sounding stations built	356
Number of buoys placed out and located	319
Number of sextant angles	448
Number of theodolite pointings	10, 622
Number of theodolite readings	13, 723
Number of compass readings for magnetic declination	702
Number of lines sounded with steamer	111
Number of lines sounded with small boats	2, 360
Number of miles sounded with steamer	1, 203
Number of miles sounded with small boats	1, 925
Number of casts of lead from small boats	95, 073
Number of casts of lead from steamer	1, 070
Number of square miles of hydrography off-shore	1, 008
Number of square miles of hydrography in-shore	130
Number of square miles of topography	137¼
Number of miles of shore-line run	175
Number of level sights taken	128
Number of observations on Polaris for determining meridian	8

Number of miles run by steamer on general duty	4,728
Number of astronomical stations occupied	8
Number of pairs of stars observed for latitude	1,131

The triangulation in Lake Michigan is shown in the accompanying sketch, marked B.

LAKE SUPERIOR.

The objects aimed at in Lake Superior were:

1. To effect a junction between the local surveys of previous years, and procure a continuous survey from west of Ontonagon, around Keweenaw Point, to Chocolate river.
2. The completion of the hydrographical survey of Keweenaw bay.
3. The preparation and measurement of a base line for triangulation.
4. The reconnoissance for the primary triangulation of the east end of the lake.
5. To read as many of the angles of the larger triangles as was practicable with the instruments that were available.
6. To determine the latitude and longitude of the principal points of triangulation.

To attain these ends the following parties were sent into the field:

First Lieutenant M. R. Brown, corps of engineers, was placed in charge of the astronómical and primary triangulation party, with instructions to divide it into three sections, placing two of them under charge of Assistants O. B. Wheeler and S. W. Robinson, and to station the different sections at the vertices of the larger triangles, and to observe for latitude, using the differential zenith telescope, and for differences of longitude, using the method of instantaneous signals, to be made at suitable points, and also to read the angles at the points occupied with the instruments furnished him.

In the latter part of September Assistant Robinson was relieved, at his own request, to enable him to accept thé position of assistant professor of engineering in the University of Michigan, and Assistant G. Y. Wisner was assigned to his duties.

First Lieutenant James F. Gregory reported for duty after all the parties had left for the field. He was assigned temporarily to assist Lieutenant Brown. Subsequently he was placed in charge of the steamer Search, and in April last, Lieutenant Brown being relieved from the lake survey by order from the department, Lieutenant Gregory was placed in charge of the astronomical computations then being made. His report of the entire operations of the party will be found herewith, marked A.

Assistant D. F. Henry was assigned to the charge of the party on board the steamer Search, and was directed to resume the reconnoissance for points of primary triangulation; to build stations; to sound lines across the lake; to make surveys of distant shoals; and to aid the astronomical party by landing them at the points to be occupied, keeping them supplied with provisions, &c.

He left this city with his party on the 23d of May, and continued on the work assigned him until August 31, when he was transferred to the base line at Portage entry, in order to commence its measurement, turning over the steamer Search to Lieutenant Gregory.

The following are the details of the work accomplished by this party:

Number of primary triangulation stations built	3
Number of base line transit stations built	4
Number of water stations built	2
Number of sounding stations	11
Number of buoys placed and located	32
Number of sextant angles	301
Number of theodolite pointings	296

Number of theodolite readings	296
Number of compass readings for magnetic declination	3
Number of lines sounded with steamer	33
Number of lines sounded with small boats	124
Number of miles sounded with steamer	785
Number of miles sounded with small boats	43
Number of casts of lead made from steamer	194
Number of casts of lead made from small boats	1,484
Number of square miles of hydrography in-shore	3
Number of miles of shore line chained and sketched	2½
Number of barometer readings	113
Number of heights measured by barometer	13
Number of miles run by steamer on general duty	4,839

Assistant Henry's report of his season's work will be found herewith, marked B.

Assistant A. C. Lamson was assigned to the charge of the party on board the steamer Surveyor, and left this city on the 22d of May.

The instructions given were to build stations for primary triangulation at points selected the season before; to cut out lines of sight; and to make a hydrographical survey of Keweenaw bay, and to the eastward along the south shore of Lake Superior, as far as possible.

The Surveyor returned to Detroit on the 23d of October, having accomplished the following work, viz:

Number of primary triangulation stations built	8
Number of sounding stations built	8
Number of sextant angles measured	60
Number of theodolite pointings	2,794
Number of theodolite readings	5,585
Number of lines sounded with steamer	117
Number of miles sounded with steamer	1,178½
Number of casts of lead from steamer	1,232
Number of square miles of hydrography off-shore	1,051½
Number of miles run with stadia for topography	1
Number of miles of line of sight opened	3
Number of miles run by steamer on general duty	2,490½

Completing the off-shore hydrography from Keweenaw Point to Laughing White Fish Point, twenty miles to the eastward of Marquette, a distance of about 150 miles.

The above work was plotted during the winter on a scale of one one-hundred-and-seventy-thousandth, and embraced 147 square inches of hydrography.

Assistant J. R. Mayer was placed in charge of a party to survey the shore-line and adjacent hydrography and topography, commencing at Keweenaw bay and working to the eastward until he joined the party of Assistant Albert Molitor, who was assigned to a similar duty beginning at Marquette and working to the westward.

The field assigned to this party comprised a portion of the east side of Keweenaw bay, and the important indentation of Huron bay extending inland about twelve miles, and affording one of the most perfectly sheltered harbors on the entire lakes, the whole of which was minutely surveyed; also, the Huron islands, which lie in the track of vessels plying between Marquette and Portage entry.

Assistant Mayer left this city with his party on the 23d of May, and returned in the latter part of October, having performed the following amount of work:

Number of secondary triangulation stations built	32
Number of sounding stations built	105
Number of buoys placed and located	133
Number of lines sounded with small boats	1,029

Number of miles sounded with small boats	763
Number of casts of the lead with small boats	28,864
Number of square miles of hydrography in-shore	53
Number of theodolite pointings	3,678
Number of theodolite readings	4,224
Number of secondary base lines measured	2
Number of meridian line observed	1
Number of miles of shore-line run with stadia	58
Number of miles run with stadia for topography	20¼
Number of square miles of topography sketched	25

The above was plotted on a scale of one sixteen-thousandth, on two sheets of antiquarian paper, and embraced 584 square inches of minute hydrography and 635 square inches of minute topography.

Assistant Albert Molitor, in charge of a similar party, left Detroit at the same time as Assistant Mayer, with instructions to commence his work at Marquette and continue to the westward until he met Assistant Mayer, which he did on the 18th of August, at Huron river, when his party was transferred to the base line at Portage entry, to assist in its measurement.

The field surveyed by Assistant Molitor included Granite island, a small but dangerous island lying in the track of commerce, and about five and three-quarter miles from the mainland, also several islands lying near the shore, which, with the indentation of the main land, afford reasonably good anchorage for vessels in almost any storms, all of which were carefully surveyed, and will be fully shown on the charts to be prepared.

A reef was also discovered by this party between Partridge island and the main shore, one rock lying but two feet beneath the surface of the water.

During the latter part of the season, after his party had been sent to the base line, Assistant Molitor was detailed to make a survey of the mouth of the Au Sable river, Lake Huron, for harbor purposes, which he accomplished, and returned to Detroit on the 17th of September.

The following are the details of the work performed by this party during the season, viz:

Number of sounding stations built	252
Number of buoys placed out and located	160
Number of lines of soundings made with small boats	1, 138
Number of miles of soundings made with small boats	924
Number of casts of the lead made with small boats	34, 786
Number of theodolite pointings	6, 467
Number of theodolite readings	8,650
Number of sexant angles	269
Number of secondary base lines	5
Number of miles of shore-line surveyed	64
Number of observations for true meridian	3
Number of compass readings for magnetic declination	24
Number of square miles of hydrography in-shore	33¼
Number of square miles of topography	25½
Number of vertical angles for topography	338

The above work was plotted on a scale of one sixteen-thousandth, covering four sheets of antiquarian paper, embracing 534¼ square inches of hydrography and 790½ square inches of topography; and in addition a map of Granite island, Lake Superior, on a scale of one five-hundredth, embracing 99½ square inches of topography.

The Au Sable survey was accomplished with the following details:

Number of sounding stations built	47
Number of theodolite pointings	217
Number of theodolite readings	225

Number of buoys placed out and located	7
Number of lines sounded with small boat	123
Number of casts of lead with small boat	2, 303

which was plotted on a scale of one twenty-four-hundredth, covering a sheet of antiquarian paper, and embracing sixty square inches of topography, and one hundred and four square inches of hydrography.

SURVEY OF THE HARBOR AT SUPERIOR CITY.

In accordance with letter from the department dated July 23, 1866, directing that a survey of the above-named point be made for the purpose of making an estimate for the improvement of the harbor, Assistant E. S. Wheeler was detailed from Assistant Henry's party for the duty on the 10th of September. He accomplished the survey in eight days. The following are the details of the work:

Number of buoys placed out and located	23
Number of theodolite pointings	309
Number of theodolite readings	309
Number of miles of shore-line chained and sketched	2
Number of square miles of hydrography in-shore	¾
Number of lines of soundings with small boats	193
Number of miles of soundings with small boats	43
Number of casts of the lead	3, 176

The above was plotted on a scale of one five-thousandth, and embraced six and one-half square inches of topography, and fifty-seven and one-half square inches of hydrography.

The total amount of work accomplished in Lake Superior during the season of 1866 is as follows:

Number of primary triangulation stations built	11
Number of secondary triangulation stations built	32
Number of sounding stations built	376
Number of water stations built	2
Number of base line transit stations built	4
Number of buoys placed and located	348
Number of sextant angles	630
Number of theodolite pointings	13, 544
Number of theodolite readings	19, 064
Number of compass bearings for magnetic declination	3
Number of lines sounded with steamer	150
Number of lines sounded with small boats	2, 484
Number of miles sounded with steamer	1, 963½
Number of miles sounded with small boats	1, 773
Number of casts of the lead from steamer	1, 426
Number of casts of the lead from small boats	68, 310
Number of square miles of hydrography off-shore	1, 051½
Number of square miles of hydrography in-shore	90
Number of square miles of topography	50½
Number of miles of shore line	126½
Number of miles run with stadia for topography	21¼
Number of observations for true meridian	3
Number of vertical angles for topography	338
Number of secondary base lines	7
Number of miles of line of sight opened	3
Number of barometer readings	113
Number of heights measured by barometer	13
Number of miles run by steamer on general duty	7, 329½

Field operations for season of 1867.

RIVER ST. CLAIR SURVEY.

Navigation being open longer by several weeks, both at the beginning and end of the season, in the St Clair and Detroit rivers than in Lake Superior, I recommended to the department to use this time for making a survey of these localities, and thus connect the surveys in Lake Erie with those in Lake Huron.

The programme for the season's operations was approved as presented. In order to carry it out, the three steamers belonging to the lake survey were at once prepared for service and despatched to the St. Clair river, with instructions to work in that locality until navigation was open into Lake Superior.

The organization was as follows: Lieutenant James Mercur, corps of engineers, was placed in charge of the steamer Search, with instructions to commence at Port Huron, at the foot of Lake Huron, and to carry the survey as far as the town of St. Clair, from which point Lieutenant B. D. Greene, corps of engineers, with the party on board the steamer Surveyor, was to carry it on to meet the work of Assistant O. N. Chaffee, who, with the party on the steamer Ada, was instructed to begin his survey near the town of Algonac, at the head of the delta of the St. Clair river, and continue the survey over the entire area covered by the delta, or as much thereof as possible, before the opening of navigation in Lake Superior.

The steamer Search left Detroit for her field of duty on the 17th of April, Lieutenant Mercur having as his assistants Messrs. Albert Molitor, Flint and Towar.

On the 31st of May the party returned to this city, having completed the duty assigned them.

The following is the amount of work accomplished:

Number of secondary triangulation stations built	41
Number of sounding stations built	130
Number of theodolite pointings	6,387
Number of theodolite readings	7,368
Number of lines sounded	645
Number of miles sounded	254⅓
Number of casts of the lead taken	10,726
Number of miles levelled	13¼
Number of miles of shore-line run	31¼
Number of miles measured with stadia	274¼
Number of square miles of topography	25
Number of vertical angles for topography	1,165
Number of compass bearings for magnetic declination	11
Number of observations for true meridian	1

The steamer Surveyor sailed with the Search (April 17,) Lieutenant Greene having as his assistants Messrs. Lamson, Paul Mayer and Marr.

She returned to Detroit on the 24th of May, the party having finished the work assigned them, the details of which were as follows:

Number of secondary triangulation stations built	71
Number of sounding stations built	161
Number of buoys placed and located	9
Number of theodolite pointings	4,681
Number of theodolite readings	4,366
Number of miles of shore-line run	32
Number of miles run with stadia	179½
Number of square miles of topography	32½
Number of miles of levelling run	16

Number of readings for levels	126
Number of bench-marks established	4
Number of feet measured with chain	5, 240
Number of lines sounded with small boat	408
Number of miles sounded with small boat	190
Number of casts of the lead	7, 733
Number of compass bearings for magnetic declination	7
Number of observations for true meridian	2

The steamer Ada left on the 16th of April, having Assistant O. N. Chaffee in charge, with Messrs. A. F. Chaffee, Foote and Wallace as assistants, and returned to this city on the 24th of May to reorganize for the season's work in Lake Superior, having surveyed 24½ miles of river course.

The following are the details of work of Assistant Chaffee's party:

Number of secondary triangulation stations	79
Number of sounding stations	280
Number of buoys placed and located	23
Number of sextant angles	75
Number of theodolite pointings	4, 627
Number of compass bearings for magnetic declination	7
Number of lines sounded with small boats	1, 014
Number of casts of the lead with small boats	19, 262
Number of miles sounded with small boats	408½
Number of square miles of topography	32
Number of miles run with stadia	84¼
Number of miles of water line sketched	25¼
Number of feet chained for secondary base line	12, 701
Number of observations for true meridian	2
Number of water gauges erected	2
Number of square miles of hydrography	8

The following is a general summary of the work performed in carrying the survey from the head of the St. Clair river to the deep water of Lake St. Clair:

Number of secondary triangulation stations built	191
Number of sounding stations built	571
Number of buoys placed out and located	32
Number of sextant angles	75
Number of theodolite pointings	15, 695
Number of theodolite readings	16, 361
Number of compass bearings for magnetic declination	25
Number of lines sounded with small boats	2, 067
Number of miles sounded with small boats	853
Number of casts of lead with small boats	37, 721
Number of square miles of topography	89½
Number of miles run with stadia for topography	538
Number of miles of shore line run	88¾
Number of miles levelled	29¼
Number of vertical angles for topography	1, 165
Number of square miles of hydrography	23
Number of observations for true meridian	5

The above comprises a complete survey of the St. Clair river from Lake Huron to the deep water in Lake St. Clair.

The following table exhibits at a glance the amount of work executed in Lakes

Superior and Michigan during the season of 1866, and in the river St. Clair previous the 30th of June, 1867:

Character of work.	Lake Michigan.	Lake Superior.	River St. Clair.	Total for year ending June 30, 1867.
Number of primary triangulation stations built	1	11	....	12
Number of secondary triangulation stations built	28	32	191	251
Number of sounding stations built	356	376	571	1,303
Number of water stations built	....	2	....	2
Number of base-line transit stations built	....	4	....	4
Number of buoys placed out and located	319	348	32	699
Number of sextant angles	448	630	75	1,153
Number of theodolite pointings	10,622	13,544	15,695	39,861
Number of theodolite readings	13,723	19,064	16,361	49,148
Number of compass bearings for magnetic declination	702	3	25	730
Number of lines sounded with steamer	111	150	....	261
Number of lines sounded with small boats	2,360	2,484	2,067	6,911
Number of miles sounded with steamer	1,203	1,963¾	....	3,166¾
Number of miles sounded with small boats	1,925	1,773	853	4,551
Number of casts of the lead from steamer	1,070	1,426	....	2,496
Number of casts of the lead from small boats	95,073	68,310	37,721	201,104
Number of square miles of hydrography off-shore	1,008	1,051¾	....	2,059¾
Number of square miles of hydrography in-shore	130	90	23	243
Number of square miles of topography	58	50½	89½	198
Number of miles of shore line	175	126¾	88½	390¼
Number of miles run with stadia for topography	137½	21¼	538	696¾
Number of observations for true meridian	8	3	5	16
Number of level sights taken	128	....	149	277
Number of vertical angles for topography	....	338	1,165	1,503
Number of secondary base lines measured	....	7	1	8
Number of miles of line of sight opened	....	3	....	3
Number of barometer readings	....	113	....	113
Number of heights measured by barometer	....	13	....	13
Number of miles run by steamers on general duty	4,728	7,329	....	12,057
Number of astronomical stations occupied	8	7	....	15
Number of pairs of stars observed for latitude	1,131	1,104	....	2,235
Number of flashes for longitude	....	527	....	527

LAKE SUPERIOR.

In accordance with the programme for the season, preparations were made for taking the field in Lake Superior as soon as possible after the opening of navigation. The plan proposed was to carry the survey from the head of the St. Mary's river westward as far as Marquette, to continue the primary triangulation and observations for latitude and longitude, and to survey as much of Isle Royale as possible. For the accomplishment of these objects the following disposition of parties was made and the field occupied in the following order:

Brevet Lieutenant Colonel F. U. Farquhar, captain corps of engineers, was placed in charge of the steamer Search, which left this city on the 7th of June, having on board the parties of Lieutenant Greene and Assistant Lamson. Colonel Farquhar was instructed—1st. To make the off-shore soundings from Grand island eastward as far as possible, or until he met the work of Assistant O. N. Chaffee. 2d. To carry supplies to the three shore parties between Marquette and the St. Mary's river, moving their camps, and giving such instructions as may be required to secure uniformity and the completion of their work. 3d. Making the necessary reconnoissance to determine the most suitable points to be occupied by the astronomical parties, and locating them at the points selected, keeping them supplied with provisions, &c., &c. 4th. Making reconnoissance for points of primary triangulation in the eastern portion of the lake. 5th. To survey all shoals or small islands beyond the limits of the shore parties' work. 6th. To have a general supervision of all the parties in Lake Superior, and, in my absence, give such instructions as might be necessary to secure satisfactory discharge of their duties.

First Lieutenant James F. Gregory, corps of engineers, was placed in charge of the party on board of the steamer Surveyor, which also sailed for Lake

Superior on the 7th of June. The duties assigned him were as follows: 1st. Making the off-shore soundings around Isle Royale, including the channel between it and the north shore. 2d. The reconnoissance for primary triangulation between Isle Royale and the north shore, erecting stations, and reading the angles of the same. 3d. The survey of all shoals or small islands beyond the limits of the work of the shore parties. 4th. Moving the two shore parties on Isle Royale, keeping them supplied with provisions, &c., &c. 5th. In the absence of myself and Colonel Farquhar, to give such instructions to the shore parties on Isle Royale as might be requisite to secure a hearty co-operation and faithful performance of the duties committed to them.

Lieutenant Gregory reports that the work has been greatly impeded by dense fogs. The shores of the island are also very bad. No dependence can be placed upon soundings, the water frequently shoaling up between soundings from fifty or sixty fathoms to a few feet, and in many places a lead-line dropped from the rocks reaches from eight to twenty fathoms.

Assistant O. N. Chaffee sailed June 8, in charge of the steamer Ada, under instructions to take up the primary triangulation of Lake Superior east of Keweenaw Point, and push it forward as rapidly as possible as far as the triangulation could be carried to the eastward. Having completed this duty, he was directed to take up the off-shore hydrography at the head of the St. Mary's river, and continue it to the northwest, around White Fish Point, until he met and connected with the work of Colonel Farquhar. He was also directed to make the necessary reconnoissance and triangulation to determine the general contour on the Canadian side of the bay south of White Fish Point.

First Lieutenant B. D. Greene, corps of engineers, was placed in charge of a party which left Detroit on the 7th of June, on board the steamer Search, for the purpose of making a topographical and hydrographical survey of the south side of the Isle Royale. He was landed on the most eastern point of the island, and instructed to continue the survey to the westward as far as possible.

Assistant A. C. Lamson also sailed on board the steamer Search, with his party, June 7, for Isle Royale, having been instructed to survey the north side of the island, commencing at the most eastern point and work to the westward as far as practicable.

The field of duty assigned these two parties comprised the numerous bays and islands forming the eastern portion of Isle Royale—as complicated and difficult portion of the coast as any in the whole extent of the lakes. The shore is almost invariably bold and rocky, and in most places so steep as to make landing impossible. Numerous deep and narrow bays, separated by rocky islets, form a succession of harbors unsurpassed in excellence and beauty. The bottom, however, is very irregular, the depth changing from many fathoms to a few feet between casts of the lead, and requiring the most minute survey to render the harbors available.

Assistant Henry Gillman sailed with his party on June 7, entrusted with the duty of making a topographical and hydrographical survey from Grand island, and continue to the westward until his work joined the survey previously made of Marquette harbor, after which his party was to be transferred to the base-line at Portage entry, to assist in its measurement.

Assistant J. R. Mayer, with his party, also sailed June 7. Assistant Mayer was instructed to commence his surveys at Grand island, and continue to the eastward until his work joined that of Assistant Molitor. The field assigned Assistant Mayer includes the well-known locality of the "Pictured Rocks," where it is unsafe to be in a small boat except in a perfect calm.

Assistant Albert Molitor was placed in charge of a similar party, and instructed to commence his surveys at the most northern point of the surveys heretofore made in the St. Mary's river and Taquamenon bay, and to continue his work from that point north and westward, around White Fish Point, until he met and closed upon the work of Assistant Mayer. This party sailed for their field of duty on June 8, and arrived at their first camping ground in Taquamenon bay on the 10th of the same month.

ASTRONOMICAL DUTY.

First Lieutenant James Mercur, corps of engineers, was placed in charge of the astronomical party.

He was directed to separate his party into three divisions, placing two of them in charge of Assistants O. B. Wheeler and G. Y. Wisner, and instructed to occupy the same stations as last season, more powerful instruments having been borrowed from the United States Coast Survey, and it is hoped that better results may be obtained.

Lieutenant Mercur left this city with his party June 20, and landed at Copper Harbor, from which point the different sections of his party were carried to their destinations by the steamer Search.

THE "SUN TELEGRAPH."

The operations of the astronomical and triangulation parties for the past three years have incidentally developed an exceedingly interesting application of the heliotrope, which is worth mentioning.

While using this instrument in Green Bay, in 1865, Assistants O. B. Wheeler and Robinson commenced communicating with each other by cutting off the light from the heliotrope in such a way as to make the telegraphic alphabet to be read by sight instead of by sound, the distance between them being about twenty miles. Practice soon enabled them to do so with facility. In 1866 the same thing was done over a distance of between fifty and sixty miles; and during the past season Assistant Wheeler sent an order for me from station Tip-Top to station St. Ignace, a distance of ninety-two miles, which order was received and obeyed.

This method of communicating intelligence must have an important bearing in military operations, for by the simple aid of a small looking-glass, or even the light of a lamp, information could be sent to the enemy almost without the possibility of detection.

On the 30th of June, the date to which a report is called for by the regulations, the several parties were engaged in the discharge of their respective duties, and were making good progress. The details of the work done by them during the season will be given in my next annual report.

OUTFLOW OF THE LAKES.

The subject of the supply of water in the chain of lakes is one that has never been examined, and as no discussion of the phenomenon of the lakes can be complete without it, I proposed to the department to commence the investigation the present season.

The suggestion having been approved, the duty was assigned to Assistant D. F. Henry, who was directed to gauge carefully the rivers forming the connecting links in the chain.

For this purpose parties were to be stationed as follows: In the St. Mary's river, below the falls; in the St. Clair river, near the town of St. Clair; in the Niagara river, below the falls; and in the St. Lawrence river, near the town of Ogdensburg.

Assistant Henry, with Assistants Foote and Flint, (who had charge of the small parties,) left this city on the 8th of June for St. Clair, where preliminary experiments were made; after which, on the 29th of June, Assistant Foote, with his party, was transferred to Sault Ste. Marie, while Assistant Flint was left to continue the work at St. Clair.

The method pursued is substantially the same as that adopted on the Mississippi river survey. (See Report on the Physics and Hydraulics of the Mississippi River, page 222, *et seq.*)

These investigations are still going on, and of course cannot now be reported upon.

METEOROLOGICAL DEPARTMENT.

On the 1st of January last Assistant D. F. Henry was placed in charge of the meteorological department of the survey. Observations have been made throughout the year at twelve stations, covering the entire chain of lakes, and the records transmitted monthly to this office, where they are reduced and tabulated.

These observations have now been continued through a period of nearly seven years, and have already produced highly interesting and important results.

The existence of a *lunar tide* has been clearly shown. The influence of the lakes upon the climate demonstrates, and recent investigations seem to indicate, the existence, during calm weather, of a *land and lake breeze.*

Indeed, the further all the investigations are carried, the more fully it is shown that all the phenomena of the ocean pertain to the lakes, and that they are justly entitled to their common appellation of "inland seas"

Assistant Henry's report will be found herewith, marked C. He has not as yet been able to discuss fully the data that have been obtained, and there yet remains much to be done.

OFFICE WORK.

In addition to the duties of the parties in the field, whose work is reduced and plotted during the winter by the assistants in charge, the details of which have been given in each case, and the reduction of meteorological observations, which has been mentioned as constantly in progress, there are other duties carried on in the office throughout the year. These consist of the

REDUCTION OF MAPS FOR THE ENGRAVER.

All the field-notes are projected on a scale of not less than one sixteen-thousandth, or about four inches to one mile.

These maps show in detail all the work that has been done, and where a larger scale is required to do this it is used. These detail maps, though invaluable as records and for reference, are, however, entirely too unwieldy for general use. They are therefore reduced to an appropriate scale for publication.

During the past year Assistant J. U. Mueller has finished a map of the north end of Lake Michigan, including the Straits of Mackinac and Green bay, on a scale of one four-hundred-thousandth, which was forwarded to the bureau on the 5th of October, 1867.

This map involved the reduction of one hundred and ten of the maps of detail, and, while it shows all the leading features of the district included within its limits, gives no idea of the amount of labor expended to produce it. Shoals that required days to survey, and upon which thousands of casts of the lead have been taken, are represented by a single figure showing the least depth. Large bays that have been minutely surveyed are represented only by shading, and a few figures to show the depth of water. It is only by an examination of the maps of detail that the value of the survey can be appreciated.

The execution of the map in question is highly creditable to Mr. Mueller.

Assistant Edward Molitor has completed the reduction of a map of the south end of Green bay, from the entrance thereof to Fox river, which was forwarded to the bureau on the 19th of August, 1867. This map, which is on the scale of one one-hundred-and-twenty-thousandth, shows in considerable detail all the dangers to navigation, as well as the harbors, anchorage, &c.

It is on the same scale as similar maps heretofore published of the Straits of Mackinac, the Beaver Island group, Grand and Little Traverse bays, and the north end of Green bay.

Mr. Molitor has executed his work with great care, and in a style fully equal to previous charts on the same scale.

The following is a list of the lake survey charts already published, and which are distributed free of charge to the vessels engaged in lake commerce:

Lake Erie,
West end Lake Erie,
Kelly's and Bass Islands,
Head of Green Bay,
Saint Clair Flats,
Tawas Harbor,
Eagle Harbor,
River Ste. Marie, No. 1,
Maumee Bay,
Ontonagon Harbor,
Thunder Bay,
Presque Isle and Middle Island,
South end Lake Huron,
West end Lake Superior,
Grand and Little Traverse Bays,
L'Anse, Keweenaw Bay,
Straits of Mackinac,
East Neebish Rapids,
Saginaw River,
Buffalo Harbor,
Beaver Group,
Agate Harbor,
River Ste. Marie, No. 2,
Eagle River,
Saginaw Bay,
Marquette Harbor,
Lake Huron,
Grand Island,
Copper Harbor,
North end Green Bay,
Portage Lake.

The data for the following charts are now in the office, and the preparation of them will be at once commenced, and as soon as they are prepared will be forwarded to the bureau for engraving.

East end of Lake Superior to Grand island. (Preliminary.)

Central portion of Lake Superior from Grand island to Ontonagon. (Preliminary.)

East end of Isle Royale, Lake Superior.

Huron bay and islands, Lake Superior.

Big and Little Sturgeon bays, Lake Michigan.

The accompanying sketch, marked A, shows at a glance the charts that have been published as well as those in preparation.

CHART DISTRIBUTION.

In addition to attending to the current business of the office, in assisting me making out vouchers and the payment of accounts, Assistants Henry Clague and H. M. Wright are charged with the duty of superintending the distribution of the published charts of the survey.

Under the regulations now in force, charts are issued to all vessels plying upon the lakes without regard to nationality. Each chart is distinctly marked with the name of the vessel and the date of presentation; also a memorandum of the understanding that "it is to be considered as the property of the vessel on change of either owner or master," and that "it will not be duplicated unless satisfactory reasons can be furnished for its loss." The distributions are made at this office, and by a special agent in Buffalo. A record is kept at both places, which are exchanged monthly, and no vessel is supplied without first examining the record to see if she has previously been furnished.

No provision is made for procuring charts in any way other than the above. The owner or master may be ready, as they frequently are, to pay any price for the charts, but we are not allowed to furnish them. The difficulty of deciding what are "satisfactory reasons" for the loss of charts has been found so great, that we have established a rule not to duplicate without proof that the vessel has been sunk or otherwise so seriously injured as to render the preservation of the charts impossible. The practical result is, that there are very many greatly needing the charts who cannot get them.

I have in my previous report called the attention of the department to this matter, and I would again most respectfully urge that some provision may be made for selling charts to all who may desire them, at the cost of printing and paper.

The demand for charts is constantly increasing, the number distributed during the past year being 5,464, or 1,829 more than the year previous.

A statement is given herewith, marked D, showing the number of each kind distributed, and the total distribution up to 30th June last.

FUTURE OPERATIONS.

The present season's operations will complete the shore-line of Lake Superior as far westward as Ontonagon, including the eastern portion of Isle Royale.

A base line five and one-half miles long will be measured, and the triangulation of Keweenaw bay completed. The scheme of triangulation is shown on the sketch submitted herewith.

The propriety of continuing the survey of Lake Superior until it is completed cannot be questioned. All that is now required previous to the preparation of charts of the eastern and middle portions of the lake is the completion of the survey of Isle Royale, and of the off-shore hydrography and the triangulation. A portion of our force in a single season will accomplish the two duties named first. The completion of the triangulation will depend upon the facilities that are furnished.

As soon as it became probable that a triangulation could be carried over a large portion, if not the whole of Lake Superior, I reported to the bureau September 6, 1865, that the instruments belonging to the survey were entirely inadequate for the work, and that the method previously adopted for reading the angles of the triangulation—that is, by visiting the stations, expecting to read them in a few hours—should be discontinued; the lines of sight being so long that they could only be seen over during the best of weather. I therefore recommend procuring instruments suitable for the purpose, and stationing small parties at the different points and leaving them until the opportunity offered for reading the angles.

The reconnoissance showed with considerable certainty that if the angles of a single triangle could be read, the triangulation could be carried over the entire lake. This was triangle "Vulcan—St. Ignace—Northeast." (See Sketch B.) During a portion of the season of 1866, parties supplied with the best of instruments that could be spared for the purpose were stationed at the vertices of this triangle, with instructions to read the angles if a favorable opportunity offered. After waiting over a month without success, the attempt was for the time abandoned.

The effort proved that the project was not impracticable; the difficulty being, first, that the instruments used had not sufficient power; and, second, that the reflectors in the heliotropes were too small.

Under these circumstances I asked for, and obtained, permission to borrow from the Coast Survey such instruments as were needed. I also had six looking-glasses of the best plate-glass, ten by fourteen inches, prepared, with rough equatorial mountings, which were to be used for throwing the reflection of the sun through an opening in a screen placed in the proper position.

The following instruments were kindly loaned me by Assistant J. E. Hilgard, in charge of the coast survey: One twenty-four inch theodolite by Troughton, reading by three micrometer microscopes to single seconds; one fourteen-inch Brünner repeating theodolite, reading by two verniers to five seconds; and one twelve-inch Gambey repeating theodolite, reading by two verniers to five seconds.

The examination made last season also showed that by changing the station northeast about four miles, an additional elevation could be obtained of about five hundred feet.

It was decided to occupy this point the present season, and, with our improved facilities and increased knowledge, make another and final attempt to read the angles required, and I am happy to report that the effort has been an entire success.

The sides of the triangle in question are respectively 92, 93.6, and 100.6 miles; its area varies but little from four thousand square miles. The angles have all been read satisfactorily, being respectively as follows:

Stations.	Angles.		
	°	′	″
St. Ignace—Vulcan—Tip-Top	56	30	39.45
Vulcan—St. Ignace—Tip-Top	66	15	6.57
Vulcan—Tip-Top—St. Ignace	57	15	6.66
Total	180	00	52.68

Showing a spherical excess very nearly what it should be.

Our success in reading the angles of this unusually large triangle by the aid of instruments borrowed from the Coast Survey demonstrates, I think, the necessity of procuring, as soon as possible, the instruments that have been asked for. I have now scarcely a doubt that the triangulation can be carried over the entire lake. There yet remain several triangles with sides nearly as long as the ones that have been obtained, and I most sincerely hope that before the commencement of another season the instruments that are necessary to execute this important and interesting work may be furnished.

The proposed scheme of triangulation is shown in the accompanying sketch, marked C.

ESTIMATES.

I have the honor to submit herewith estimates for continuing the survey for the fiscal year ending June 30, 1869, on the same scale and general plan that has heretofore been adopted.

Very respectfully, your obedient servant,

W. F. RAYNOLDS,
Lieut. Col. of Engineers, Brevet Brig. Gen. U. S. A.

Brevet Major General A. A. HUMPHREYS,
Chief of Engineers U. S. A., Washington, D. C.

Summary of the report on the survey of the north and northwest lakes for the year ending June 30, 1867.

I have the honor to submit the following summary of the operations of the lake survey for the year ending June 30, 1867:

One steamer and two shore parties were engaged during the summer of 1866 in Lake Michigan, carrying the survey of both shores to the southward, and in executing the primary triangulation, off-shore soundings, &c.

The work was carried on the west side to a point near Two Rivers, Wisconsin, and on the east side of the lake to Little Point au Sable, giving a connected survey from these points to the foot of Lake Huron and head of Green bay. The amount of work done in Lake Michigan was as follows:

Number of primary triangulation stations built	1
Number of secondary triangulation stations built	28
Number of sounding stations built	356
Number of buoys placed out and located	319
Number of sextant angles	448

Number of theodolite pointings	10, 622
Number of theodolite readings	13, 723
Number of compass readings for magnetic declinations	702
Number of lines sounded with steamer	111
Number of lines sounded with small boats	2, 360
Number of miles sounded with steamer	1, 203
Number of miles sounded with small boats.	1, 925
Number of casts of the lead from steamer	1, 070
Number of casts of the lead from small boats	95, 073
Number of square miles of hydrography, off-shore	1, 008
Number of square miles of hydrography, in-shore	130
Number of square miles of topography	137¼
Number of miles of shore line run	175
Number of level sights taken	128
Number of observations on Polaris for determining meridian	8
Number of miles run by steamer on general duty	4, 728
Number of astronomical stations occupied	8
Number of pairs of stars observed for latitude	1, 131

Two steamers and two shore parties were engaged in Lake Superior in connecting between previous surveys in Keweenaw bay and at Marquette, and in making reconnoissance for primary triangulation over the entire lake, and in making an hydrographical survey from Keweenaw Point to Grand island.

The amount of work done in Lake Superior was as follows:

Number of primary triangulation stations built	11
Number of secondary triangulation stations built	32
Number of sounding stations built	376
Number of water stations built	2
Number of base line transit stations built	4
Number of buoys placed out and located	348
Number of sextant angles	630
Number of theodolite pointings	13, 544
Number of theodolite readings	19, 064
Number of compass bearings for magnetic declination	3
Number of lines sounded with steamer	150
Number of lines sounded with small boats	2, 484
Number of miles sounded with steamer	1, 963½
Number of miles sounded with small boats	1, 773
Number of casts of the lead from steamer	1, 426
Number of casts of the lead from small boats	68, 310
Number of square miles of hydrography, off-shore	1, 051½
Number of square miles of hydrography, in-shore	90
Number of square miles of topography	50½
Number of miles of shore line	126½
Number of miles run with stadia for topography	21¼
Number of observations for true meridian	3
Number of vertical angles for topography	338
Number of secondary base lines	7
Number of miles of line of sight opened	3
Number of barometer readings	113
Number of heights measured by barometer	13
Number of miles run by steamer on general duty	7, 329½

Three astronomical parties were engaged, during the first of the season, in Lake Superior, and subsequently in Lake Michigan, in determining the latitude of points by the aid of the differential zenith telescope, and differences of longitude by means of instantaneous signals; and also in reading the angles of primary triangles at some of the points occupied. Seven points in Lake Superior and eight on Lake Michigan were occupied, and the following work done:

2,235 pairs of stars observed for latitude.

2,192 stars observed for instrumental correction, time, &c.

1,222 pointings of theodolite for primary triangulation.

In the months of April and May, 1867, parties on board three steamers were engaged in the survey of the St. Clair river, and the survey was completed from Port Huron to include the greater portion of the "Delta," comprising the following amount of work:

Number of secondary triangulation stations built	191
Number of sounding stations built	571
Number of buoys placed out and located	32
Number of sextant angles	75
Number of theodolite pointings	15,695
Number of theodolite readings	16,361
Number of compass readings for magnetic declination	7
Number of lines sounded with small boats	2,067
Number of miles sounded with small boats	853
Number of casts of the lead	37,721
Number of square miles of topography	89½
Number of miles run with stadia for topography	538
Number of miles of shore line run	88¾
Number of miles levelled	29¼
Number of vertical angles for topography	1,165
Number of square miles of hydrography	23

The following table shows the total amount of work done in the different localities during the season ending June 30, 1867:

Character of work.	Lake Michigan.	Lake Superior.	River St. Clair.	Total for year ending June 30, 1867.
Number of primary triangulation stations built	1	11	....	12
Number of secondary triangulation stations built	28	32	191	251
Number of sounding stations built	356	376	571	1,303
Number of water stations built	....	2	....	2
Number of base-line transit stations built	....	4	....	4
Number of buoys placed out and located	319	348	32	699
Number of sextant angles	448	630	75	1,153
Number of theodolite pointings	10,622	13,544	15,695	39,861
Number of theodolite readings	13,723	19,064	16,361	49,148
Number of compass bearings for magnetic declination	702	3	25	730
Number of lines sounded with steamer	111	150	....	261
Number of lines sounded with small boats	2,360	2,484	2,067	6,911
Number of miles sounded with steamer	1,203	1,963¼	....	3,166¼
Number of miles sounded with small boats	1,925	1,773	853	4,551
Number of casts of the lead from steamer	1,070	1,426	....	2,496
Number of casts of the lead from small boats	95,073	68,310	37,721	201,104
Number of square miles of hydrography off-shore	1,008	1,051¼	....	2,059¼
Number of square miles of hydrography in-shore	130	90	23	243
Number of square miles of topography	58	50½	89½	198
Number of miles of shore line	175	126½	88¾	390¼
Number of miles run with stadia for topography	137¼	21½	538	696¾
Number of observations for true meridian	8	3	5	16
Number of level sights taken	128	....	149	277
Number of vertical angles for topography	....	338	1,165	1,503
Number of secondary base lines measured	....	7	1	8
Number of miles of line of sight opened	....	3	....	3
Number of barometer readings	....	113	....	113
Number of heights measured by barometer	....	13	....	13
Number of miles run by steamers on general duty	4,728	7,329	....	12,057
Number of astronomical stations occupied	8	7	....	15
Number of pairs of stars observed for latitude	1,131	1,104	....	2,235
Number of stars observed for instrumental correction, time, &c.	....	2,192	....	2,192
Number of pointings of theodolite for primary triangulation	....	1,222	....	1,222

The above work in Lakes Michigan and Superior was plotted during the past winter, and comprised 26 sheets of antiquarian paper, embracing 2,725½ square inches of topography and 2,290¾ square inches of hydrography. The St. Clair work has not as yet been projected, the parties having gone into the field immediately upon its completion.

Five thousand four hundred and sixty-four lake survey charts have been distributed during the year, or 1,829 more than the year previous.

One detail chart of the south end of Green bay, on a scale of one one-hundred-and-twenty-thousandth, and one of the north end of Lake Michigan, including the straits of Mackinac and Green bay, on a scale of one four-hundred-thousandth, have been completed and forwarded to the bureau for publication.

At the date to which this report is made the following force was engaged in prosecuting the operations of the survey:

3 steamers in Lake Superior.
5 shore parties in Lake Superior.
3 astronomical parties in Lake Superior.
2 gauging parties, measuring the outflow of the rivers St. Mary's and St. Clair.
13 meteorological observers at different points.
2 draughtsmen, reducing maps for publication.
2 assistants, in office and attending to chart distribution.
3 assistants, engaged in reducing meteorological observations, copying, &c.

Respectfully submitted:

W. F. RAYNOLDS,
Lieut. Col. of Engineers, Brevet Brig. Gen. U. S. A.

Brevet Major General A. A. HUMPHREYS,
Chief of Engineers U. S. A., Washington, D. C.

Estimate for continuing the survey of the north and northwest lakes, including Lake Superior, for the fiscal year to commence July 1, 1868, *and end June* 30, 1869.

For three parties for hydrographical and general triangulation reconnoissance, one for each of the lake survey steamers Search, Surveyor, and Ada, the cost of each party will be as follows, viz:

One assistant, 183 days, at $4 80 per day	$880 40	
One assistant, 183 days, at $3 60 per day	658 80	
One assistant, 183 days, at $3 per day	549 00	
One recorder, 183 days, at $1 25 per day	228 75	
One sailing-master, 183 days, at $2 75 per day	503 25	
One mate, 6 months, at $50 per month	300 00	
One steam engineer, 183 days, at $2 50 per day	457 50	
One assistant steam engineer, 183 days, at $1 50 per day	274 50	
One carpenter, 183 days, at $2 per day	366 00	
One steward, 183 days, at $1 50 per day	274 50	
One cook, 183 days, at $1 50 per day	274 50	
One second cook, 183 days, at $1 per day	183 00	
Four firemen, 183 days, at $1 25 per day	915 00	
Fourteen seamen, 183 days, at $1 per day	2,562 00	
Subsistence for the above thirty persons, 183 days, at 50 cents each per day	2,745 00	
550 tons coal for fuel, at $10 per ton	5,550 00	
Total for one party	16,672 20	
For three parties		$50,016 60

For three astronomical, magnetic, and primary triangulation parties, as follows:

One assistant, 183 days, at $4 80 per day	$880 40	
One assistant, 183 days, at $2 50 per day	457 50	
One cook, 150 days, at $1 50 per day	225 00	
Five men, for boats' crews and laborers, 150 days, at 80 cents per day.	600 00	
Transportation of parties, provisions, camp-equipage, &c., to and from the field, at $250 each way	500 00	
Subsistence of eight men, 150 days, at 50 cents per day	600 00	
Total for one party	3,262 90	
For three parties		$9,788 70

For five topographical and hydrographical parties to survey shore-line and adjacent hydrography and topography, the cost will be as follows:

One assistant, 183 days, at $4 80 per day	$880 40	
One assistant, 183 days, at $3 60 per day	658 80	
One recorder, 183 days, at $1 50 per day	274 50	
One foreman, 165 days, at $1 40 per day	231 00	
One steward, 165 days, at $1 40 per day	231 00	
One cook, 165 days, at $1 40 per day	231 00	
One waiter, 165 days, at $1 per day	165 00	
Two leadsmen, 165 days, at $1 per day	330 00	
Two chainmen, 165 days, at 90 cents per day	297 00	
Fourteen boatmen, 165 days, at 80 cents per day	1,848 00	
Subsistence of above twenty-five men, 165 days, at 50 cents each per day	2,062 50	
Expenses in purchase of tools, buoy flags, rope, leads, lead-lines, materials for stations, camp and mess equipage, &c	600 00	
Transportation of twenty-five men to and from the field, at $20	1,000 00	
Expense of moving provisions, camp equipage, &c., each way, at $250	500 00	
Total for one party	9,309 20	
For five parties		46,546 00

For two parties for gauging the outflow of the lakes, the cost will be as follows, viz:

One assistant, 183 days, at $3 50 per day	$640 50	
One assistant, 183 days, at $2 per day	366 00	
Six men, 165 days, at $2 each per day, including board	1,980 00	
Board of two assistants, 165 days, at $1 each per day	330 00	
Transportation to and from the field, at $150	300 00	
Total for one party	3,616 50	
For two parties		7,233 00

Office and miscellaneous expenses:

Office rent and fuel for one year	$1,800 00
Pay of two draughtsmen for reducing maps for engraving, one year of 365 days, at $5 30 each per day	3,869 00
Four assistants, heads of parties, 182 days, at $5 30 each	3,858 40
Two assistants, heads of parties, 182 days, at $4 70 each	1,710 80
Two assistants, heads of parties, 182 days, at $4 10 each	1,492 40
One accountant, 365 days, at $4 10 per day	1,496 50
One accountant, 365 days, at $3 50 per day	1,277 50
Six assistants, 182 days, at $3 50 per day	3,822 00
One assistant, 182 days, at $2 90 per day	527 80
Four copyists and recorders, 365 days, at $2 50 per day	3,650 00
One office servant, 365 days, at $1 50 per day	547 50
Three steamers in ordinary, at $1,000 each	3,000 00
Commutation of fuel and quarters for nine officers of the corps of engineers	5,000 00
Travelling expenses of superintendent and assistants while attending to the duties of the survey	750 00

Expenses in office, drawing-paper and materials, stationery, Nautical Almanacs, &c	$600 00	
Expense of meteorological and tide-gauge observers for one year	4,000 00	
Total estimate for office and miscellaneous expenses for one year		$37,401 90
Add 10 per cent. to cover contingent expenses, such as purchase of tools, boats, camp equipage, &c		15,098 62
Total estimate		166,084 82

Respectfully submitted:

W. F. RAYNOLDS,
Lieutenant Colonel of Engineers, Bvt. Brig. Gen. U. S. A.

Brevet Major General A. A. HUMPHREYS,
Chief of Engineers U. S. Army, Washington, D. C.

A.—*Lieutenant Gregory's report on the astronomical work for the season of* 1866.

OFFICE UNITED STATES LAKE SURVEY,
Detroit, Michigan, May 31, 1867.

SIR: I have the honor to submit the following report of the operations in the astronomical department of the lake survey since the date of the last annual report:

To First Lieutenant M. R. Brown, corps of engineers, was assigned the charge of the astronomical party last season; all the field work was therefore performed under his direction. He also supervised and aided in the performance of office work until March 12, 1867, when, he being removed from the lake survey, I was assigned to duty in his place.

Lieutenant Brown took the party into the field with instructions to separate it into three divisions, and to locate the divisions at the best practicable points for the astronomical determination of the large primary triangles of Lake Superior. The first triangle selected was Vulcan, Northeast, and St. Ignace. This triangle covers an area of so great an extent that it may be well to give it a more minute description than it is necessary to accord the others, which, though large, were determined with comparatively little difficulty.

Vulcan station is situated on the highest available eminence on Keweenaw Point, the first platform of the station being eight hundred feet above the lake and seventy-five above the ground.

The point selected on St. Ignace island is twelve hundred and eighty-nine feet above the lake, and at Northeast an elevation of nine hundred and forty-five feet above the lake was reached.

Michipicoten island was at first considered the proper location for the station, but, on examination, it was found that the greatest height was but nine hundred and twenty-nine feet above the lake, and the horizon of this point and that of Vulcan being twenty-five miles apart, it was decided best to occupy the location on the Northeast coast.

The lengths of the sides of this triangle, as since determined by the latitudes and difference of longitudes of the stations at the apices, are: Vulcan-St. Ignace, 93.0 miles; Vulcan-Northeast, 96.6 miles; and St. Ignace-Northeast, 88.46 miles.

Neither the powder flashes of several nights, nor the heliotrope's light for several days, having been seen, the latitudes of the stations were approximately determined, and also the differences of longitude, by transportation of chronometers, in order to determine the azimuths of the stations from each other. The land not being visible, it was necessary that the observers should be able to direct their instruments towards the points where the signals were made, a slight deviation having heretofore thrown the flashes out of the field of view of the telescopes. After this determination, the flashes were plainly visible by the aid of the telescope, and were frequently seen by the unaided eye, when it was known exactly where to look for them. This triangle being the largest, was therefore the most difficult to determine.

The three others, viz., Vulcan-St. Ignace and Isle Royale, Vulcan-Isle Royale-Whealkate, Vulcan-Whealkate and Huron Mount, were similarly determined, and a description of the means employed for the determination of one will therefore apply to the others.

The differences in longitude were determined by means of a series of powder flashes made on several nights by the observers at the three stations, the times of the individual flashes being arranged according to a programme previously prepared. The instant of each flash was recorded at all those stations by chronometers, of which the errors and rates were determined nightly. The difference of the local times of each flash, as recorded by the several observers, is the approximate difference in longitude between the stations. The mean of the difference of local times of each night's flashes is the mean result for that night. A mean of all the nights' flashes is given as a final result.

The method for the determination of latitude was that of opposite and nearly equal meridian zenith distances. The zenith telescope was the instrument employed for this purpose.

At all the stations azimuths of prominent objects were determined by frequent observations of Polaris at elongation and culmination. At Vulcan station connection was made with the topographical station located there in 1865.

At the close of the season's work in Lake Superior the party was removed to Lake Michigan, where observations were made for the latitudes of eight stations.

The results obtained during the past winter from the observations made last season I have arranged in tables as follows:

Tables 1 to 8, inclusive, contain the general and final results, with probable error of single, mean, and final results, for the latitudes of eight stations in Lake Michigan, viz: Cana Island, Whitefish Point, Clay Banks, Kewaunee, Sheboygan, Big Point au Sable, Rawley's Point, and Little Point au Sable.

Tables 9 to 15, inclusive, contain general and final results, with probable errors of single, mean, and final results, for the latitude of seven stations in Lake Superior, viz: North East, Vulcan, St. Ignace, Whealkate, Isle Royale, Huron Mount, and Marquette.

Table No. 16 contains the latitudes of primary triangulation stations, as determined from the astronomical stations; and when the observations were made near no triangulation station the latitude of the nearest shore-line stake is given.

Table No. 17 contains results for differences in longitude between the stations at the apices of the four large primary triangles in Lake Superior. In the table will be found the number of flashes recorded at each station for each night, the mean results for differences in longitude for each night, and the final result, or mean of all the nights, as reduced to the primary triangular stations.

The observers and the instruments used by them at the various stations are as follows: Lieutenant M. R. Brown and Assistant G. Y. Wisner observed at Vulcan station for latitude and difference of longitude, and for latitude at Kewaunee, Whitefish Point, and Sheboygan. I was with the division under Lieutenant Brown a portion of the time during which observations were made at Vulcan station.

The instruments used by this division were Würdemann transit No. 15, of 32-inch focal length, and zenith telescope No. 1, of same focal length.

Assistant O. B. Wheeler, aided by Mr. G. H. Benzenbergh, observed for latitude and difference of longitude at St. Ignace and Whealkate stations, and for latitude at Big Point au Sable and Little Point au Sable stations. The instruments used were Würdemann transit No. 1, 32-inch focal length, and zenith telescope No. 15, same focal length.

Assistant S. W. Robinson and Mr. A. A. Robinson observed for latitude and difference of longitude at North East, Isle Royale, and Huron Mount stations, and for latitude at Cana Island, Clay Banks, and Rawley's Point stations. The instrument used was a transit, prime vertical and zenith telescope, combined, of 26-inch focal length, manufactured by Ristor & Martin, Berlin.

To the astronomical party was also assigned the duty of reading the angles of the four large primary triangles before mentioned, as well as could be done with the instruments furnished. This was not satisfactorily accomplished. The instruments furnished to the observers were unreliable and entirely unfit for accurate work; and on two of the lines, viz., Vulcan–North East and Vulcan–St. Ignace, the distances were so great—being respectively 96.6 miles and 93 miles—that the heliotropes were never seen. The other lines of these triangles have all been seen over, and the angles approximately measured by aid of the heliotrope; it is, therefore, confidently expected that, with good instruments and the employment of some apparatus to enable the observers to read the angles at night, all the angles can be successfully measured. That steady, brilliant lights, used after dark, could be seen, and angles measured between them at distances at which the heliotrope cannot be seen, I think beyond a doubt. The powder flashes made at North East and St. Ignace stations, for differences in longitude, were frequently distinctly visible at Vulcan station to the unaided eye, on those nights when extraordinary refraction appeared the greatest, and, as before stated, the heliotropes were never seen over these lines.

The extraordinary refraction, or mirage, which is at times so wonderfully great in Lake Superior region, can be made of so much importance in aiding the long lines of sight, that a brief account of some of its exhibitions may be useful and interesting. The following extracts are from Lieutenant Brown's field report for the season 1866. This was at Vulcan station:

"In order to test the amount of refraction at night, and to ascertain how much advantage would be found in attempting to obtain readings to lights at night, instead of using the heliotrope, I kept watch, or had some one stationed to watch, on favorable nights, for the Grand Island light—one of the fourth-order, distant about 85 miles, and elevated 287 feet above the lake. It was seen for short intervals several times, indicating an addition of height of over a thousand feet, given in effect to the light by extraordinary refraction; the first platform of Vulcan station being 800 feet above the lake.

"On one occasion during the past summer I saw land in the vicinity of Portage entry, not over 150 feet in height, elevated to an apparent height of over 2,000 feet, judging by comparison with the known height of Whealkate, which was not much affected at the time, and this without much distortion of outline. The appearance lasted over a half an hour."

This phenomenon is no rare occurrence, scarcely a clear day passing without greater or less exhibitions of it. It is usually noticeable from the middle of the afternoon until after sunset, the greatest effects having been noticed just before sunset. The strange and varied appearances presented by land, as seen at great distances over the lake, and sometimes at short distances, have been witnessed by nearly all the persons connected with the lake survey.

Assistant Wisner states that when engaged at Vulcan station, he saw, on one occasion, three distinct apparitions, one above the other, of the heliotrope, at Isle Royale station; the lowest of these was of a ruddy orange-color, the middle one a pure white, and the top one a very pale white. At another time he saw two apparitions of the same heliotrope, both clearly distinct and of the same color. The distance between the heliotropes appeared to be about the elevation of the island above the water-line. The island itself was also greatly elevated in appearance on both of these occasions. The distance between Vulcan and Isle Royale stations is 59.3 miles, Vulcan being 800 feet and Isle Royale station 400 feet above the lake.

When at the station on Point Abbeye, in September last, I saw the Huron islands elevated in appearance to at least twice their real height, and above them appeared their inverted images; the station on the top of West Huron island being in contact with the station on its inverted image.

The distance from Point Abbeye station to that on Huron island is not over seven miles. On the same afternoon the whole of Keweenaw Point, as seen from Point Abbeye, was greatly elevated, and also with an inverted image above it. These appearances frequently assume many varied forms in the course of a few minutes, and again appear fixed for sometimes nearly an hour at a time.

I append, also, some sketches, the originals of which were made by Assistant Robinson, when at North East station, illustrating the appearances presented by Isle St. Ignace to an observer at North East station, 88.46 miles distant, on the afternoons of August 13 and September 10, 1866.

The office-work of the past season has been performed by Lieutenants M. R. Brown, James Mercur, B. D. Greene, corps of engineers, Assistants O. B. Wheeler and G. Y. Wisner, and myself, Assistant S. W. Robinson having left the survey last fall, on the arrival of the party from the field.

Each reduction has been computed by two persons, each working entirely independent of the other. Their results have afterwards been carefully compared and corrected.

All who have been connected with this department of the survey since I assumed direction of the work have performed their parts with assiduity and zeal; and to Assistants Wheeler and Wisner I am especially indebted for their constant attention to the work, for which their ability and experience has peculiarly fitted them.

I am, sir, very respectfully, your obedient servant,

JAMES F. GREGORY,
First Lieutenant Corps of Engineers.

Brevet Major General A. A. HUMPHREYS,
Chief of Engineers U. S. A., Washington, D. C.

Latitude of lake survey astronomical station, Cana island, Lake Michigan.

TABLE NO. 1.—GENERAL RESULTS.

Date.	No. of pairs observed.	Mean results for each night.	Probable error of a—	
			Single result.	Mean result.
1866.		° ′ ″	″	″
September 30	40	45 05 16.73	± 0.706	± 0.112
October 1	129	45 05 16.58	0.897	0.079
October 2	31	45 05 16.69	1.290	0.232
Sum	200	Probable error of final result .... = ± 0.065 Final result .... = 45° 05′ 16.″475 = ± 0.065		

Latitude of lake survey astronomical station, White Fish Point, Lake Michigan.

TABLE NO. 2.—GENERAL RESULTS.

Date.	No. of pairs observed.	Mean results for each night.	Probable error of a—	
			Single result.	Mean result.
1866.		° ′ ″	″	″
October 1	33	44 52 50.88	± 1.996	± 0.347
October 2	64	44 50 50.26	1.618	0.202
Sum	97	Probable error of final result = ± 0.172		
		Final result = 44° 52′ 50.″47 ± 0.172		

Latitude of lake survey astronomical station, Clay Banks, Lake Michigan.

TABLE NO. 3.—GENERAL RESULTS.

Date.	No. of pairs observed.	Mean results for each night.	Probable error of a—	
			Single result.	Mean result.
1866.		° ′ ″	″	″
October 4	20	44 41 15.72	± 0.968	± 0.216
October 5	127	44 41 15.25	1.119	0.099
Sum	147	Probable error of final result = ± 0.090		
		Final result = 44° 41′ 15.″31 ± 0.090		

Latitude of lake survey astronomical station, Kewaunee, Lake Michigan.

TABLE NO. 4.—GENERAL RESULTS.

Date.	No. of pairs observed.	Mean results for each night.	Probable error of a—	
			Single result.	Mean result.
1866.		° ′ ″	″	″
October 7	52	44 27 12.27	± 0.932	± 0.122
October 8	58	44 27 11.63	0.783	0.109
Sum	110	Probable error of final result ± 0.″076		
		Final result 44° 27′ 11.″93 ± 0.″076		

Latitude of lake survey astronomical station, Sheboygan, Lake Michigan.

TABLE No. 5.—GENERAL RESULTS.

Date.	No. of pairs observed.	Mean results for each night.	Probable error of a— Single result.	Probable error of a— Mean result.
1866.		° ′ ″	″	″
October 13	44	43 45 54.00	± 0.970	± 0.146
October 15	38	43 45 54.39	0.972	0.158
Sum.............	82	Probable error of final result.............. = ± 0.″107 Final result............... = 43° 45′ 54.″13 ± 0.″107		

Latitude of lake survey astronomical station, Big Point au Sable, Lake Michigan.

TABLE No. 6.—GENERAL RESULTS.

Date.	No. of pairs observed.	Mean results for each night.	Probable error of a— Single result.	Probable error of a— Mean result.
1866.		° ′ ″	″	″
October 4	25	44 03 30.36	± 0.670	± 0.134
October 5	68	44 03 30.70	0.865	0.105
October 6	48	44 03 30.20	0.678	0.098
Sum.............	141	Probable error of final result.............. = ± 0.″064 Final result .... = 44° 03′ 30.″47 ± 0.″064		

Latitude of lake survey astronomical station, Rawley's Point, Lake Michigan.

TABLE No. 7.—GENERAL RESULTS.

Date.	No. of pairs observed.	Mean results for each night.	Probable error of a— Single result.	Probable error of a— Mean result.
1866.		° ′ ″	″	
October 8	93	44 11 34.86	± 0.839	± 0.087
October 9	54	44 11 34.67	0.793	0.107
Sum.............	147	Probable error of final results.............. = ± 0.″069 Finale result........... ......44° 11′ 34.″785 ± 0.069		

Latitude of lake survey astronomical station, Little Point au Sable, Lake Michigan.

TABLE NO. 8.—GENERAL RESULTS.

Date.	No. of pairs observed.	Mean results for each night.	Probable error of a—	
			Single result.	Mean result.
1866.		° ″	″	″
October 14............	10	43 40 25.00	± 0.626	± 0.198
October 15............	73	43 40 23.72	0.839	0.098
October 16............	65	43 40 23.70	0.851	0.105
October 17............	59	43 40 24.16	0.739	0.096
Sum..............	207	Probable error of final results.............. = ± 0.″056 Final result.................. = 43°40′23.″90 ± 0.056		

Latitude of lake survey astronomical station, north east coast, Lake Superior.

TABLE NO. 9—GENERAL RESULTS.

Date.	No. of pairs observed.	Mean results for each night.	Probable error of a—	
			Single result.	Mean result.
1866.		° ′ ″	″	
June 29...............	15	48 15 36.95	± 0.555	± 0.143
July 7...............	26	48 15 38.88	1.369	0.268
July 8...............	30	48 15 38.29	0.593	0.108
July 10...............	31	48 15 38.88	0.768	0.138
July 17...............	4	48 15 39.60	0.407	0.203
August 11.............	3	48 15 { 39.72 25.87	0.405	0.234
August 15.............	25	48 15 { 38.47 24.92	0.762	0.152
Sum.............	134	Probable error of final result.............. = ± 0.″070 Finale result.................. 48 15 38.519 ± 0.″070		

Latitude of lake survey astronomical station, Vulcan, Lake Superior.

TABLE NO. 10.—GENERAL RESULTS.

Date.	No. of pairs observed.	Mean results for each night.	Probable error of a—	
			Single result.	Mean result.
1866.		° ′ ″	″	″
August 15.............	29	47 26 44.07	± 1.153	± 0.210
August 16.............	20	47 26 44.32	1.415	0.316
August 17.............	30	47 26 44.10	0.883	0.161
August 18.............	5	47 26 44.58	0.764	0.341
Sept. 16.............	7	47 26 44.81	0.613	0.232
Sept. 17.............	4	47 26 44.13	0.699	0.349
Sept. 18.............	6	47 26 44.95	0.942	0.384
	101	Probable error of final result.............. = ± 0.104 Final result.................. 47 26 44.251 ± 0.104		

Latitude of lake survey astronomical station, Saint Ignace, Lake Superior.

TABLE NO. 11.—GENERAL RESULTS.

Date.	No. of pairs observed.	Mean results for each night.	Probable error of a—	
			Single result.	Mean result.
1866.		° ′ ″	″	″
August 3	14	48 47 26.99	± 0.856	± 0.228
August 4	23	48 47 28.12	0.451	0.009
August 9	25	48 47 28.49	0.041	0.008
August 14	8	48 47 28.56	1.298	0.459
August 15	41	48 47 28.33	0.672	0.104
August 16	1	48 47 28.20		
August 21	23	48 47 28.36	0.890	0.185
August 28	4	48 47 29.45	0.883	0.440
August 29	9	48 47 27.98	0.650	0.216
Sum	148	Probable error of final result		= ± 0″.058
		Final result		48° 47′ 28″.23 ± 0″.058

Latitude of lake survey astronomical station, Whealkate, Lake Superior.

TABLE NO. 12.—GENERAL RESULTS.

Date.	No. of pairs observed.	Mean results for each night.	Probable error of a—	
			Single result.	Mean result.
1866.		° ′ ″	″	″
September 18	3	47 04 19.27	± 0.445	± 0.314
September 21	29	47 04 18.48	0.706	0.131
September 24	25	47 04 18.68	0.576	0.115
September 25	46	47 04 18.24	0.330	0.048
Sum	103	Probable error of final result		= ± 0″.052
		Final result		47° 04′ 18″.44 ± 0″.052

Latitude of lake survey astronomical station, Isle Royale, Lake Superior.

TABLE NO. 13.—GENERAL RESULTS.

Date.	No. of pairs observed.	Mean results for each night.	Probable error of a—	
			Single result.	Mean result.
1866.		° ′ ″	″	″
August 26	4	48 07 55.925	± 0.741	± 0.053
September 1	59	48 07 54.586	0.736	0.095
September 2	65	48 07 54.644	0.846	0.105
September 3	23	48 07 55.291	0.764	0.159
September 16	39	48 07 54.807	0.629	0.100
Sum	190	Probable error of final result		= ± 0″.056
		Final result		48° 07′ 54″.807 ± 0″.056

Latitude of lake survey astronomical station, Huron mountain, Lake Superior.

TABLE NO. 14.—GENERAL RESULTS.

Date.	No. of pairs observed.	Mean results for each night.			Probable error of a—	
					Single result.	Mean result.
1866.		°	′	″	″	″
September 20	4	46	52	49.3	± 0.196	± 0.098
September 21	33	46	52	51.7	0.236	0.041
September 24	151	46	52	51.6	1.035	0.084
September 25	124	46	52	51.9	1.217	0.107
Sum	312	Probable error of final result Final result				= ± 0″.064 46° 52′ 51″.719 ± 0″.064

Latitude of lake survey astronomical station, Marquette, Lake Superior.

TABLE NO. 15.—GENERAL RESULTS.

Date.	No. of pairs observed	Mean results for each night.			Probable error of a—	
					Single result.	Mean result.
1865.		°	′	″	″	″
July 10	19	46	31	59.85	± 1.005	± 0.231
July 25	30	46	32	00.07	0.604	0.110
July 26	32	46	31	59.70	0.968	0.171
July 30	35	46	32	00.02	1.030	0.175
Sum	116	Probable error of final result Final result				= ± 0″.084 = 46° 31′ 59″.92 ± 0″.084

Latitudes of lake survey primary triangulation stations, or shore line stakes nearest to astronomical stations.

TABLE NO. 16.—DETERMINED 1866.

	Names of primary triangulation stations, or shore line stakes.	North latitude.			Difference in latitude from astronomical stations.
		°	′	″	″
LAKE MICHIGAN.	Little Point au Sable, stake No. 161	43	40	22.76	— 01.64
	Big Point au Sable	44	03	27.76	— 02.71
	Kewaunee, observing post No. 3	44	27	14.00	+ 03.00
	Clay Banks	44	41	15.793	— 00.483
	Cana island	45	05	16.475	00.00
	White Fish Point, stake No. 11	44	52	50.68	+ 00.21
		°	′	″	″
LAKE SUPERIOR.	Northeast	48	15	24.27	— 14.249
	Saint Ignace	48	47	28.87	+ 00.64
	Vulcan	47	26	44.251	00.00
	Whealkate	47	04	18.125	— 00.315
	Isle Royale	48	07	54.794	+ 00.29
	Huron mountain	46	52	52.495	+ 00.776

Results for differences in longitude reduced to primary triangulation stations, Lake Superior—Season, 1866.

TABLE NO. 17.

Date.	Number of flashes.	Difference of longitude.	Number of flashes.	Difference of longitude.	Number of flashes.	Difference of longitude.
		St. Ignace west of Vulcan.		Vulcan west of North East.		St. Ignace west of North East.
1866.		′ ″		′ ″		′ ″
Aug. 4	2	00 13.98	2	6 46.36	3	7 00.38
Aug. 6	8	00 14.22	7	6 46.18	8	7 00.53
Aug. 14	10	00 13.89	11	6 46.23	10	7 00.23
Mean ...	......	....	......	6 46.26	......	7 00.38
				Isle Royale west of Vulcan.		Isle Royale west of St. Ignace.
				′ ″		′ ″
Aug. 26			9	3 04.63		
Aug. 27	6	00 13.80	10	3 04.76	6	2 51.06
Aug. 28	6	00 14.17	10	3 04.94	7	2 50.80
Aug. 29					7	2 50.75
Aug. 30	9	00 13.84	9	04.61	9	2 50.78
Mean ...	......	00 13.98	......	....	......	2 50.85
		Whealkate west of Vulcan.				Whealkate west of Isle Royale.
		′ ″				′ ″
Sept. 9	6	3 27.36	7	3 04.66	11	00 22.77
Sept. 10	21	3 27.26	21	3 04.74	21	00 22.53
Sept. 13	20	3 27.44	20	3 04.70	21	00 22.76
Mean ...	......	....	......	3 04.72	......	00 22.69
				Huron mountain west of Vulcan.		Whealkate west of Huron mountain.
				′ ″		′ ″
Sept. 19		3 27.24	17	00 30.56	18	2 56.64
Sept. 20		3 27.65	26	00 30.73	27	2 56.91
Sept. 21		3 27.07	24	00 30.42	26	2 56.65
Sept. 24		3 27.12				
Mean ...	......	3 27.31	......	00 30.57	......	2 56.73

B.—*Assistant D. F. Henry's report for season of* 1866.

OFFICE UNITED STATES LAKE SURVEY,
Detroit, November 1, 1866.

SIR: I have the honor to submit the following report of work accomplished during the past season:

After having finished the winter's work, and made comparisons of the base apparatus to test the compensation of the tubes, on the 14th of May left Detroit on the steamer Search, to look again for the shoals at the mouth of the Detroit river. In my report for the month of May, I gave a detailed report of my search, and success in finding one about three miles from Bar Point.

On the morning of the 24th of May, I again left Detroit on the steamer

Search, for Lake Superior, in accordance with your orders, a copy of which I enclose, having on board the parties of Assistants Mayer and Molitor.

Being detained by adverse winds, I was not able to land them until the 29th: Assistant Molitor about ten miles above Marquette, near Partridge island, and Assistant Mayer on the east side of Huron bay.

I next visited the base line on l'Anse bay, and found that the progress made in the grubbing was very satisfactory.

I ran a transit line through the cut on the side. I then went to Copper Harbor and looked at the location of Vulcan station, which Assistant Lamson was then building.

On the 4th of June I took Lieutenant M. R. Brown on board, and ran over to the north shore. After much detention on account of bad weather, I selected the points for the main triangulation, on Isle St. Ignace, Michipicoton island, and one on the northeast coast.

The land on that side is very much broken, and the hills mostly bare on top. The rocks are almost entirely of the igneous formation. At St. Ignace my barometrical determination of the height differed only eight feet from Bayfield's estimate.

I made, while at St. Ignace, a partial survey of the harbor in which we lay. This differed so little from Bayfield's sketchings as to again make me wonder at the wonderful accuracy with which he did his work, considering the time and means at his disposal.

At Michipicoton I had little trouble in finding the highest point, a hill about 930 feet above the lake.

On the northeast coast I was more troubled, the hills six or eight miles from the shore being much higher than those near by; but I selected a point which you afterwards approved of—a bare hill about 940 feet high, and about two miles back. Assistant Robinson has since found the height of the hills back to be about 1,500 feet, and therefore much better point for the station.

On the 20th of June I returned to Copper Harbor, where I found the parties of Assistants Wheeler and Robinson. I took them on board and ran to Portage entry, where I found you and Brevet Brigadier General O. M. Poe, corps of engineers. We then ran back to the north shore, and landed the above parties at stations Northeast and St. Ignace, and returned to Copper Harbor by way of Fort Williams and Isle Royale, on the 26th. After visiting the camp of Assistants Mayer and Molitor we ran to Marquette, where you and General Poe left for Detroit.

On the 29th I visited the base line, to examine the progress of the grubbing, &c.

On the 30th I sounded out to and around Stannard's Rock.

On the 2d of July I made a minute topographical sketch of Little Gull isle, near Manitou island, for light-house purposes, and commenced repairing and whitewashing the primary triangulation stations at Kewenaw bay.

On the 5th I took Mr. Harding down on the base line, and inspected and accepted three miles of it.

On the 7th I ran to Isle Royale and commenced building a 30-foot station on the point selected by you. This station occupied me until the 12th, and then I was detained by the fogs (which have hung over the lake, particularly near the north shore, for the greater part of the season) until the 16th, when I ran for Copper Harbor.

On the 18th and 19th, I built two water stations on Stannard's Rock, and made a minute survey of it. What is known as Stannard's Rock is the highest part of the shoal, and is a mass of porphyritic trap about twenty feet across, and rising about three feet above the present level of the water. The bad part of the shoal extends about one-half mile north-northwest from the rock, at which distance there is only two and one-half feet of water over the rocks. The ridge extends about four miles north by east from the rock, where it falls off from 26 fathoms to 70 fathoms.

On the south and east sides the water is very deep, while on the west and north it runs off very gradually. One of the stations I built on the north shoal and the other on the rock itself. The latter still remained the last time I visited the rock, the 28th of August, although we had had two or three severe storms.

I think there is no doubt a day-beacon might be constructed which would stand through all the seasons. I got a base line for the location of the buoys by stretching a small cord, of which the length was known, over a series of floats, from the rock nearly at right angles with the line between the stations. Simultaneous angles were then read from each station, between the other and a flag at the end of the cord.

I also at this time sounded several lines with the steamer connecting the shoal with the shore work of Keweenaw.

On the 20th I took Lieutenant Brown and supplies for the north shore parties on board, and run over to the northeast. The next day we run to St. Ignace, and then back to northeast, carrying a chronometer with us to determine the difference of time between the stations, in order to get their approximate azimuth from Vulcan.

Running back to Copper Harbor, I spent the next few days in repairing stations and steamer soundings around Stannard's Rock, and after going to Marquette for coal, I run over to the north shore in a dense fog extending all across the lake, to move the astronomical parties up on the hill, according to your instructions.

On the 3d of August I ran back to Marquette, where you came on board. The 6th we ran to Houghton, visiting on the way the camps of Assistants Mayer and Molitor, and the base line.

The next day we ran to Copper Harbor, sounding a line out to Stannard's Rock on the way, and then tried to do the sounding off Copper Harbor, but the weather would not permit. Made a survey of the improvement at Lac La Belle, and then ran to Portage entry and Marquette, visiting Assistants Mayer and Molitor on the way.

On the 10th Assistant E. S. Wheeler was by your orders sent to Superior City, to make a resurvey of the mouth of St. Louis river.

On the 12th, you having left for Detroit, I ran to Copper Harbor.

On the 16th I ran over to the north shore, and moved Assistant Robinson's party to Isle Royale, having to go to Fort William on the way for powder.

Having run back to Copper Harbor on the 21st, I was from that time until the 25th trying to get Assistant Molitor's party on board, a strong wind blowing all the time from the northwest. At the latter date I moved him over to the base line to commence the grading.

On the 30th Assistant E. S. Wheeler rejoined me.

After having run to Marquette for coal, on the 31st I landed the base apparatus, &c. I turned over the steamer Search to Lieutenant J. F. Gregory, and went into camp on shore to measure the base line.

Whenever practicable, I have sounded lines when running across the lake. The deepest water (978 feet) was found about thirty miles off Manitou island.

The water seems to be generally deeper on the south side of the lake, though the higher hills on the north side made me think it would be different.

The bottom of the lake, where the depth is from sixty to ninety fathoms, is red sand and clay. This clay is of all shades of yellow and brown. Where the depth exceeds ninety fathoms the bottom is almost invariably clay. I have a number of specimens, and I hope they will be examined by a good microscopist, to ascertain whether it contains any of the infusoria found at the bottom of the ocean.

In sounding a line from Manitou island to Pie island, I found a very remarkable ridge, on which the water was less than 100 fathoms in depth, though there is 150 fathoms on each side of it.

During the season I also visited the Batteau Rock, about twenty miles from Isle Royale, which forms a shoal very similar to Stannard's Rock, and on which I think a day beacon would be of great advantage; for, although there is very little commerce as yet with the north shore, yet during the summer months steamers with pleasure parties are frequently running to Isle Royale and Thunder Bay, and might in thick weather get far enough from their course to run on these rocks.

For a month after going into camp it rained almost every day, and in fact we had not more than two weeks good weather during the whole time I was there.

I built a comparator house twenty-two feet long, six feet wide, and eight feet high, in which I put up the comparator posts, and made comparisons of the standard bar and tubes.

Assuming the bar to be the same length as formerly, then these comparisons show that tube No. 1 is 0.0027 inches longer than it was in 1864, and that tube No. 2 is 0.0057 inches shorter. This is probably due to the putting in the new agates, and general repairs made by William Würdemann last year.

Last fall there were but about one-half dozen wet spots on the whole base line, but now it is nearly covered with water, and requires side ditches the greater part of the length of it to carry off the surface water. The subsoil being hard clay upon sandstone, having an almost horizontal stratification, there is no natural drainage, and but little absorption of water falling on the surface.

About eight thousand feet was prepared for measurement, and after the side ditches had taken off most of the water I commenced measurement.

I sank a stone five feet long, having a brass frustum of a pyramid let into its upper surface under the south base station, and two other reference stones about 100 feet on each side, at right angles to the line.

Contact was made with a plumb line of fine copper wire, let down from the centre of a trivet on the centre post, the bob of 4½ weight being over a point in the brass.

I measured 284 tubes, but the ground was so shaky in places as to make even that unreliable. I closed the measurement on a point in a brass, similar to the one at the commencement, let into a stone four feet long sunk beneath the surface of the ground.

On the 14th, having received orders to return to Detroit, I put my party n board of the steamer Search, ran to Houghton to communicate your orders to Assistant Lamson, and on the 16th went to Assistant Mayer's camp and took his party on board.

After coaling at Marquette I ran to Grand island, where I left three shore party boats.

I then went to Middle island, Lake Huron, to find a reported shoal between the island and mainland. As there was a vessel still on the shoal, I had but little trouble in finding and locating it. Having made a minute survey of it I ran to Detroit, arriving here on the 18th.

Since that time I have been engaged in laying up the steamer, and in making a plot of the shoal found.

I beg leave, here, to thank Assistant E. S. Wheeler and Recorder David Wallace, for the able, efficient, and willing manner in which they have performed all their duties during the past season.

Very respectfully, your obedient servant,

D. F. HENRY,
Assistant Lake Survey.

Colonel W. F. Raynolds,
Corps Engineers, Superintendent Lake Survey, Detroit.

C.—*Meteorological report.*

OFFICE UNITED STATES LAKE SURVEY,
Detroit, May 31, 1867.

SIR: I have the honor to submit the following report on the reductions of the meteorological records kept at the several lake survey stations.

On the 1st of January, by your orders, I took charge of the meteorological department, and have therefore had but little time to make the necessary reductions, and have been obliged to omit some important parts of the observations.

The situation of the several stations are as follows:

Superior, at the head of Lake Superior, near the mouth of St. Louis river. Latitude (approximately) 46° 46′ 30″ north; longitude 92° 03′ 28″ west; height of observatory above the lake, forty feet. Observer, E. H. Bly. It is protected on the west side by a range of hills rising about 600 feet above the lake, and on the east side by a lower range forming a valley through which the prevailing winds, northeast, have a free sweep from the lake.

Ontonagon, at the mouth of Ontonagon river, on the south side of Lake Superior; latitude 46° 52′ 30″ north; longitude 89° 30′ 30″ west; height of observatory above the lake, ten feet. Observer, Hampton B. Smith. A range of high hills runs from five to twelve miles back of the town, which is thus protected from the southerly winds, but fully open to those from the lake.

Marquette, east of the middle of the south side of Lake Superior; latitude 46° 32′ 51″ north; longitude 87° 22′ 57″ west; height of observatory above the lake, ninety-two feet. Observer, H. S. Bacon. Hills from 400 to 600 feet high are on the east and south of the town. The height of Lake Superior above the sea level is about 620 feet.

Milwaukee, on the west side of Lake Michigan, opposite the widest part of the lake; latitude 43° 03′ north; longitude 87° 55′ west; height of observatory above the lake, fifteen feet. Observer, J. A Lapham. A range of low hills are situated to the northwest and southwest of the city, which is fully exposed to the winds from the lake, but those from the land are much broken in their force.

Grand Haven, on the eastern side of the lake, at the mouth of Grand river, directly opposite Milwaukee; latitude 43° 05′ north; longitude 86° 12′ 33″ west; height of observatory above the lake, twelve feet. Observer, Heber Squier. A range of sand dunes breaks the winds from the north and east. Lake Michigan is approximately 576 feet above the sea.

Thunder Bay island, Lake Huron; latitude 45° 02′ 13″ north; longitude 83° 11′ 26″ west; height of observatary above the lake, forty feet. Observer, J. J. Malden. A low rocky island about two miles from the shore, which is of the same character. It is situated north of the centre of the lake, and is fully exposed to all winds.

Tawas City, on a bay of the same name, near the mouth of Saginaw bay, Lake Huron, opening to the south and west; latitude 44° 15′ 57″ north; longitude 83° 30′ 54″ west; height of observatory above the lake, thirteen feet. Observer, C. H. Whittemore. A range of high lands to the north and east of the town protects it from winds from those quarters.

Lake Huron is about 570 feet above the sea.

Detroit, on a river of the same name; latitude 42° 19′ 58″ north; longitude 83°, west; height of observatory above the river, twelve feet. Observer, John Brennan. Country low and flat all around the city. Approximate height of the river above the sea, 550 feet.

Monroe City, at the western end of Lake Erie; latitude 41° 53′ 36″ north; longitude 83° 19′ 26″ west; height of observatory above the lake, seven feet. Observer, John Lane. Country much the same as at Detroit, but the town is exposed to the northeast winds from the lake.

Cleveland, near the middle of the southern side of Lake Erie; latitude 41° 30′ north; longitude 81° 47′ west; height of observatory above the lake, eighty-five feet. Observer, Benj. A. Stanard. The city is built on the bluffs overlooking the lake, and has but little high land back of it.

Buffalo, at the eastern extremity of Lake Erie; latitude 42° 53′ north; longitude 78° 55′ west; height of observatory above the lake, twenty-five feet. Observer, Edward Dorr. Country rather low and flat, but exposed to the southwest and west winds from the lake. The approximate height of Lake Erie above the sea level is 544 feet.

Fort Niagara, at the mouth of the Niagara river, at the western end of Lake Ontario; latitude 43° 15′ north; longitude 79° 55′ west; height of observatory above the lake, 27.5 feet. Observer, Lewis Leffman. Fully exposed to winds from the lake, but somewhat protected from the low hills to the south, which form the Falls of Niagara.

Charlotte, at the mouth of Genesee river, near the middle of the southern side of Lake Ontario; latitude 43° 12′ 34″ north; longitude 77° 51′ west; height of observatory above the lake, 37.5 feet. Observer, Andrew Mulligan. The town lies on both sides of the valley formed by the Genesee river; low hills to the west and south.

Sackett's Harbor, on a bay at the eastern end of Lake Ontario; latitude 43° 55′ north; longitude 75° 57′ west; height of observatory above the lake, 30.6 feet. Observer, Henry Metcalf. Country around the town low and flat, exposed to all winds from the westward. Lake Ontario is about 235 feet above the sea.

GENERAL METEOROLOGICAL REDUCTIONS.

In tables A will be found the reductions of the observations at the several stations, from July to December, inclusive, for 1866. The reductions for the rest of this year were given in the last report.

In these the barometer has been reduced to the freezing point; the elasticity, the humidity, and the gaseous pressure of the atmosphere, computed from the psychrometer readings; and the winds resolved and reduced.

Tables B give the maximum, minimum, and mean of the barometer and thermometer, and the amount of rain-fall for the months, seasons and years, since the commencement of the observations.

Tables C, D, and E, are compiled from the above, and show the stage of the barometer and thermometer, and amount of rain-fall for the several years.

By comparing the mean yearly mean of the barometer given in the last column but one of table C, with the mean for the several years given in table F, it will be seen that the greatest amount of mean of any year differs from the general mean is 0.083 inch, and that the average variation is less 0.05 inch. Therefore, the means given in the tables differ from the means of the several stations, probably less than 0.01 inch.

In the same manner comparing tables D and G, we find the mean temperature for each year differs from the general mean temperature by less than a degree.

The range of the barometer given in table C is only that of the extremes of the tri-daily observations, and is therefore smaller than the true range.

The range of temperature is obtained from the extreme readings of the maximum and minimum thermometers.

In the following tables the stations are grouped according to their latitudes, and the general mean and range of the temperature given. The temperature generally increases as the latitude decreases, though there are some anomalies. Milwaukee is nearly two degrees colder than Grand H aven, thoughthe latitude is about the same.

Superior has a lower temperature than Ontonagon or Marquette, though there is little difference in the latitudes of the three places. This may be due to the valley formed by the hills on each side of the former place, through which the northeast winds of the lake draw with great violence. Again, the temperature of Tawas City is a degree and a half higher than that of Thunder bay. This is also due to the position of the two stations, the latter being fully exposed, and the former only open to southwesterly winds.

The range also varies greatly, but this is probably due to one station not being affected by some warm or cold spell, which is experienced at another, as the observations are for a series of years.

Table showing the change of temperature for different latitudes

Stations.	Latitude.			Longitude.			Temperature.	
							Mean.	Range.
	°	′	″	°	′	″	°	°
Ontonagon	46	52	30	89	30	30	....	135
Superior	46	46	30	92	3	28	38.5	137
Marquette	46	32	51	87	22	57	41.5	136
Thunder Bay island	45	2	13	83	2	34	42.6	118
Tawas City	44	15	57	83	30	54	44.2	115
Sackett's Harbor	43	55	0	75	57	0	46.9	131
Fort Niagara	43	15	0	79	55	0	46.6	108
Charlotte	43	12	54	77	51	0	48.1	118
Grand Haven	43	5	0	86	12	33	47.3	107
Milwaukee	43	3	0	87	55	0	45.8	127
Buffalo	42	53	0	78	55	0	47.0	118
Detroit	42	19	58	83	0	0	48.1	117
Monroe City	41	53	36	83	19	26	49.5	122
Cleveland	41	30	0	81	47	0	49.8	111

In the following table the stations are grouped according to their height above the sea level, and the mean and range of the barometrical readings given.

This also shows some rather curious anomalies, but none of much consequence.

Table showing the relation of the height of the barometer to the height of the station above the sea.

Stations.	Height above the sea.	Barometer + 28 inches.	
		Mean.	Range.
	Feet.		
Marquette	710	1.262	2.109
Superior	660	1.301	1.978
Ontonagon	630	....	1.729
Cleveland	629	1.321	1.997
Thunder Bay island	610	1.341	2.079
Milwaukee	591	1.358	2.056
Grand Haven	588	1.353	1.896
Tawas City	583	1.359	2.552
Buffalo	569	1.359	2.136
Detroit	562	1.368	2.078
Monroe City	551	1.392	2.041
Charlotte	272.5	1.699	2.310
Sackett's Harbor	265.6	1.692	2.182
Fort Niagara	262.5	1.732	2.077

HALF-HOURLY OBSERVATIONS AT THUNDER BAY ISLAND.

A series of half-hourly observations was taken during two years, from December 1, 1863, to November 30, 1865, at Thunder Bay island, Lake Huron. These have been reduced in the same manner as the general meteorological abstract given in table A.

Table I gives the monthly means of the above, and table K the means of the several half hours for spring, summer, autumn, winter, and for the two years.

The latter tables are graphically represented in diagram 1. In the first line of the diagram are given the curves of the total and gaseous atmospheric pressure represented by a full and broken line respectively. To save room the curves were not plotted according to their relative height, and the gaseous is placed above the total curve, though it properly should be below.

In the second line are given the curves of temperature, the dry-bulb being represented by a full, and the wet by a broken line; in the third the relative amount of humidity in the atmosphere; in the fourth, the relative amount of rain-fall for each hour; in the fifth, the velocity of the wind; and at the bottom are given the resultant directions from which the wind blew at each hour.

The times of the maxima and the minima of the barometer, thermometer, and of the humidity, are given in the following tables, the first of which is arranged according to the state of the atmosphere, and the second according to the seasons.

Table showing the time of the maximum, minimum, and mean of the barometer, thermometer, and humidity at Thunder Bay island for two years from December 1, 1863, to November 30, 1865.

State.	Spring.		Summer.		Autumn.		Winter.		Year.	
	Hour.	Amount.	Hour.	Amount.	Hour.	Amount.	Hour.	Amount.	Hour.	Amount.
BAROMETER, TOTAL PRESSURE + 28 INCHES.										
	h. m.		h. m.		h. m.		h. m.		h. m.	
1st minimum	5 00 a.m.	1.310	....	....	3 30 a.m.	1.370	5 00 a.m.	1.326	4 30 a.m.	1.352
1st maximum	10 00 a.m.	1.331	10 00 a.m.	1.417	10 30 a.m.	1.381	9 30 a.m.	1.342	10 00 a.m.	1.367
2d minimum	4 00 p.m.	1.304	600 p.m.	1.383	3 00 p.m.	1.354	2 00 p.m.	1.314	3 00 p.m.	1.341
2d maximum	10 30 p.m.	1.324	....	....	9 00 p.m.	1.376	7 30 p.m.	1.342	10 30 p.m.	1.358
Mean	2 00 a.m. 6 30 a.m. 1 00 p.m. 8 00 p.m.	1.317	6 30 a.m. 0 30 p.m.	1.408	3 30 a.m. 12 00 m. 7 00 p.m.	1.370	1 00 a.m. 7 30 a.m. 11 30 a.m. 5 30 p.m.	1.332	2 00 a.m. 6 00 a.m. 0 30 p.m. 8 00 p.m.	1.354
BAROMETER, GASEOUS PRESSURE + 28 INCHES.										
1st maximum	0 30 a.m.	1.163	3 30 a.m.	1.000	12 00 mid.	1.108	9 30 a.m.	1.246	2 00 a.m.	1.125
1st minimum	3 30 p.m.	1.125	4 30 p.m.	0.931	2 30 p.m.	1.058	5 30 a.m.	1.232	3 00 p.m.	1.082
2d maximum	....	....	....	....	....	....	7 30 p.m.	1.244	....	....
2d minimum	....	....	....	....	....	....	1 30 p.m.	1.209	....	....
Mean	6 30 a.m. 7 30 p.m.	1.147	8 00 a.m. 8 30 p.m.	0.966	10 00 a.m. 7 00 p.m.	1.092	4 00 a.m. 6 30 a.m. 11 30 a.m. 5 30 p.m.	1.234	10 00 a.m. 7 30 p.m.	1.110
THERMOMETER, DRY-BULB.										
Minimum	3 30 a.m.	32.5	3 30 a.m.	57.4	5 00 a.m.	45.0	3 30 a.m.	20.7	4 30 a.m.	39.0
Maximum	2 00 p.m.	41.9	2 30 p.m.	69.7	2 30 p.m.	52.6	2 30 p.m.	26.2	2 00 p.m.	47.6
Mean	8 00 a.m. 7 30 p.m.	37.1	8 00 a.m. 7 30 p.m.	63.4	9 00 a.m. 8 00 p.m.	47.7	10 00 a.m. 8 30 p.m.	23.0	8 30 a.m. 8 00 p.m.	42.8
THERMOMETER, WET-BULB.										
Minimum	3 00 a.m.	30.5	3 30 a.m.	54.5	4 30 a.m.	42.7	3 30 a.m.	18.8	3 30 a.m.	36.6
Maximum	2 00 p.m.	37.6	2 00 p.m.	61.8	2 30 p.m.	47.6	2 30 p.m.	23.7	2 00 p.m.	42.6
Mean	7 30 a.m. 8 30 p.m.	33.4	7 30 a.m. 7 30 p.m.	58.2	9 00 a.m. 7 30 p.m.	44.6	9 30 a.m. 8 30 p.m.	20.9	8 30 a.m. 7 30 p.m.	39.4
HUMIDITY.										
Minimum	5 30 a.m.	.783	4 30 a.m.	.821	6 30 a.m.	.812	5 30 a.m.	.725	5 30 a.m.	.783
Maximum	3 30 p.m.	.644	2 30 p.m.	.620	2 00 p.m.	.677	2 00 p.m.	.662	3 00 p.m.	.653
Mean	9 30 a.m. 8 30 p.m.	.716	9 00 a.m. 8 30 p.m.	.725	9 30 a.m. 8 00 p.m.	.755	10 30 a.m. 8 00 p.m.	.698	9 30 a.m. 8 30 p.m.	.725

State.	Barometer + 28 inches.				Thermometer.				Humidity.	
	Total.		Gaseous.		Dry-bulb.		Wet-bulb.			
	Hour.	Amount.	Hour.	Amount.	Hour.	Amount.	Hour.	Amount.	Hour.	Amount.
SPRING.										
	h. m.		*h. m.*		*h. m.*		*h. m.*		*h. m.*	
1st minimum	5 00 a.m.	1.310	3 30 p.m.	1.125	3 30 a.m.	32.5	3 00 a.m.	30.5	3 30 p.m.	.644
1st maximum	10 00 a.m.	1.331	0 30 a.m.	1.163	2 00 p.m.	41.9	2 00 p.m.	37.6	5 30 a.m.	.783
2d minimum	4 00 p.m.	1.304								
2d maximum	10 30 p.m.	1.324								
Mean	2 00 a.m. 6 30 a.m. 1 00 p.m. 8 00 p.m.	1.317	6 30 a.m. 7 30 p.m.	1.147	8 00 a.m. 7 30 p.m.	37.1	7 30 a.m. 8 30 p.m.	33.4	9 30 a.m. 8 30 p.m.	.716
SUMMER.										
1st minimum			4 30 p.m.	0.931	3 30 a.m.	57.4	3 30 a.m.	54.5	2 30 a.m.	.620
1st maximum	10 00 a.m.	1.417	3 30 a.m.	1.000	2 30 p.m.	69.7	2 00 p.m.	61.8	4 30 p.m.	.783
2d minimum	6 00 p.m.	1.383								
2d maximum										
Mean	6 30 a.m. 0 30 p.m.	1.408	8 00 a.m. 8 30 p.m.	0.966	8 00 a.m. 7 30 p.m.	63.4	7 30 a.m. 7 30 p.m.	58.2	9 00 a.m. 8 30 p.m.	7.25
AUTUMN.										
1st minimum	3 30 a.m.	1.370	2 30 p.m.	1.058	5 00 a.m.	45.0	4 30 a.m.	42.7	2 00 p.m.	.677
1st maximum	10 30 a.m.	1.381	12 00 m.	1.108	2 30 p.m.	52.6	2 30 p.m.	47.6	6 30 a.m.	.812
2d minimum	3 00 p.m.	1.354								
2d maximum	9 00 p.m.	1.276								
Mean	3 30 a.m. 12 00 m. 7 00 p.m.	1.370	10 00 a.m. 7 00 p.m.	1.092	9 00 a.m. 8 00 p.m.	47.7	9 00 a.m. 7 30 p.m.	44.6	9 30 a.m. 8 00 p.m.	.755

WINTER.

1st minimum	5 00 a.m.	1.326	3 30 a.m.	1.232	3 30 a.m.	20.7	3 30 a.m.	18.8	2 00 p.m.	.662
1st maximum	9 30 a.m.	1.342	9 30 a.m.	1.246	2 30 p.m.	26.2	2 30 p.m.	23.7	5 30 a.m.	.725
2d minimum	2 00 p.m.	1.314	1 30 p.m.	1.209	....	....	....	....	....	....
2d maximum	7 30 p.m.	1.342	7 30 p.m.	1.244	....	....	....	....	....	....
Mean	1 00 a.m. 7 30 a.m. 11 30 a.m. 5 30 p.m.	1.332	4 00 a.m. 6 30 a.m 11 30 a.m. 5 30 p.m.	1.234	10 00 a.m. 8 30 p.m.	23.0	9 30 a.m. 8 30 p.m.	20.9	10 30 a.m. 8 00 p.m.	.698

YEAR.

1st minimum	4 30 a.m.	1.352	3 00 p.m.	1.082	4 30 a.m.	39.0	3 30 a.m.	36.6	3 00 p.m.	.653
1st maximum	10 00 a.m.	1.367	2 00 a.m.	1.125	2 00 p.m.	47.6	2 00 p.m.	42.6	5 30 a.m.	.783
2d minimum	3 00 p.m.	1.341	....	....	....	....	....	....	....	....
2d maximum	10 30 p.m.	1.358	....	....	....	....	....	....	....	....
Mean	2 00 a.m. 6 00 a.m. 0 30 p.m. 8 00 p.m.	1.354	10 00 a.m. 7 30 p.m.	1.110	8 30 a.m. 8 00 p.m.	42.8	8 30 a.m. 7 30 p.m.	39.4	9 30 a.m. 8 30 p.m.	.725

It will be noticed that the barometric curve shows the usual double daily maxima and minima, except during the summer season, when, from a cause which I cannot explain, we only have the usual first maximum and second minimum.

The gaseous pressure curve shows a double maximum and minimum during the winter, and has an indication of the same in the spring.

This shows how little dependence can be placed on the readings of the psychrometer when the temperature of the air is much below freezing, even in the hands of a careful observer, and I would, therefore, recommend the discontinuance of the reading of that instrument when the temperature is below freezing.

The first minimum of the total pressure varies from 3.30 to 5 a. m.; the second, from 2 to 4 p. m, (excluding the summer minimum as anomalous;) the first maximum from 9.30 to 10.30 a. m; and the second from 7.30 to 10.30 p. m.

Of the gaseous pressure the maximum is from midnight to 3 a. m., and the minimum from 2.30 to 4.30 p. m., the winter curve being incorrect on account of the lowness of the temperature.

In the thermometer curves, the almost perfect parallelism of the curves of the dry and wet bulbs during the winter shows, as before noticed, the want of accuracy in the instrument during cold weather.

The minimum of the dry bulb occurs at 3 30 a. m. during the spring, summer, and winter, but in autumn it is at 5 a. m., while the maximum occurs at 2 p. m. in the spring, and at 2 30 p. m. during the rest of the year.

The minimum of the wet bulb varies from 3 to 4 30 a. m., and the maximum from 2 to 2 30 p. m., being a little in advance of the maximum and minimum of the dry bulb.

I intended to compute from the observations, tables for the hourly connections for the periodic and non-periodic variations of temperature, but have been obliged to postpone it on account of want of time.

The humidity curves have their maxima from 4.30 to 6.30 a. m., or from one to two hours subsequent to the time of minimum temperature, and their minima from 2 to 3.30 p. m. being after the maximum of temperature during the spring and summer, and before during the autumn and winter.

The very depressed winter curve is probably due to the incorrectness of the psychrometer before mentioned.

The curve of downfall of rain and snow generally shows a maximum at about 4 in the morning, and again about 4 in the afternoon, the minimum being about 10 in the morning, and again in the night, thus being opposed to the curve of barometric pressure.

I have never seen this noticed elsewhere, and these records are too limited to establish a general rule of correspondence between the curves, though I think the subject is worthy of further investigation.

The velocity of wind curves shows a maximum shortly after midnight, and a minimum after noon; this is in accordance with the general impression that the wind blows harder during the night than the day, which is commonly true during warm weather, but I did not expect to see it so marked during the storms of winter. During the spring the course of the wind varies quite regularly, considering the shortness of the time of observation, from north 5° west at midnight to north 24° east at 11 a. m.; in the summer from north 47° west at 4 a. m., to north 80° east at 2 p m.; in the autumn from north 87° west at 5 a. m., to north 22° west at 3 p. m.; in the winter from north 71° west at 9 a. m., to north 50° west at 6 p. m.; thus showing that the course of the wind varies during the day opposite to the apparent motion of the sun even during the winter storms, and the differing directions in the several seasons. This subject will be more fully discussed under the head of land and lake breezes.

In the lower lines of tables K, I have given the means of twenty-four hours, and also the means of one hour's tri-daily observation, viz: 7 a. m. and 2 and

9 p. m., for the seasons and years. These will be found, together with their differences, in the following tables:

ANEMOGRAPH RECORDS.

Table showing the means of the barometer, &c., for 24 hours, and for 7 a. m. and 2 and 9 p. m.

State.	Spring.		Summer.		Autumn.		Winter.		2 years.	
	24 hrs.	7, 2, & 9.	24 hrs.	7, 2, & 9.	24 hrs.	7, 2, & 9	24 hrs.	7, 2, & 9.	24 hrs.	7, 2, & 9.
Barometer + 28 inches.										
Total pressure	1.317	1.317	1.408	1.400	1.370	1.368	1.332	1.328	1.354	1.353
Gaseous pressure	1.147	1.145	0.966	0.962	1.092	1.088	1.234	1.228	1.110	1.106
Thermometer.										
Dry bulb	37°.1	37°.7	63°.4	64°.2	47°.7	48°.4	23°.0	23°.5	42°.8	43°.4
Wet bulb	33°.4	34°.5	58°.2	58°.8	44°.6	44°.9	20°.9	21°.3	39°.4	39°.9
Cloudiness	6.9	6.9	5.4	5.5	7.3	7.3	8.2	8.1	7.0	7.0
Wind.										
Direction	N. 6° E.	N. 6° E.	N. 24° W	N. 8° W	N. 52° W	N. 58° W	N. 59° W	N. 61° W	N. 34° W	N. 31° W
Force	1.9	1.9	1.0	0.7	1.1	0.9	2.3	2.1	1.4	1.2

Table showing the differences between the quantities in the above table.

[+ signifies that the 7, 2, and 9 means are greater than those for 24 hours; — the reverse.]

Seasons.	Barometer.		Temperature.		Cloudiness.	Wind.	
	Total.	Gaseous.	Dry bulb.	Wet bulb.		Direction.	Force.
Spring	0.000	— 0.002	+ 0.6	+ 1.1	0.0	0.0	0.0
Summer	— 0.008	— 0.004	+ 0.8	+ 0.6	+ 0.1	— N. 16° W.	— 0.3
Autumn	— 0.002	— 0.004	+ 0.7	+ 0.3	0.0	+ N. 6° W.	— 0.2
Winter	— 0.004	— 0.006	+ 0.5	+ 0.4	— 0.1	+ N. 2° W.	— 0.2
Two years	— 0.001	— 0.004	+ 0.6	+ 0.5	0.0	— N. 3° W.	— 0.2

It will be seen from the foregoing that the differences of the barometic means at the hours of the tri-daily observations and for the whole day amount to almost nothing, while the temperature varies about a half degree.

The cloudiness is the same, and even the force and direction of the wind correspond very nearly.

Tables L give the hourly records of the direction and relative velocity of the wind at Milwaukee for 1861. These were omitted in the discussion of the winds in the report for 1865, and are added here to complete the records at Milwaukee.

I have not had time to discuss the winds at the several stations for the two years; they are behind, but hope to be able to do so another season.

These records were taken from the sheets of Burnell's Anemograph, kept at Milwaukee by Observer J. A. Lapham.

This instrument is a late invention, and as its mode of working is peculiar, a description of it may not be out of place.

The paper, which is about six inches wide, passes over horizontal rollers moved by clock work at the rate of four feet in twenty-four hours, each hour being marked upon it by a needle point properly adjusted and attached to the striking train of the clock.

A vertical, hollow iron rod is brought down through the roof of the building near one side of the paper. Above the roof this rod bears a long arm to which a vane is attached. Fixed on this rod, just above the level of the paper, are four eccentrics, one above another, and arranged so that their points of greatest eccentricity are 90° apart.

In a frame above the paper are four bars, one above the other, playing freely, horizontally, one end of each bar being pressed firmly against one of the eccentrics by means of a spiral spring. To each of these bars is attached a vertical pencil, so placed that it touches the paper at intervals about an inch and a quarter across it. When the vane is properly set, these pencils represent the four cardinal points of the compass, north, east, south, and west, reckoning from the edge of the paper furthest from the rod, and as the vane turns the rod and the eccentrics are moved from maximum to minimum, they play over about an inch in the width of the paper.

The operation of the machine will be most plainly seen by giving a few examples.

If the wind is northerly the vane will be moving to the east and west of north, and the north pencil will be pushed by its eccentric to its maximum, and the east and west pencils will be at and nearly at their minimum, and on the moving paper will be drawn three jagged lines, one near the maximum of the north and the other near the minimum of the east and west spaces respectively, while the south pencil will make a straight line at its minimum.

If the wind is northeast the north and east pencils will make jagged lines near the centre of their respective spaces, and the south and west pencils will make straight lines at the minima of theirs. In this manner, by dividing the spaces between the maxima and minima, all the points of the compass may easily be read.

In order to ascertain exactly the position of the spaces, continuous straight lines are drawn on the paper by eight pointed lead weights properly fixed in the framework and resting on the paper.

The velocity of the wind is shown by the anemometer first constructed by Dr. Robinson, of Armaugh, Scotland, which consists of four hemispherical cups attached to arms projecting at right angles from a common axle.

To this axle is affixed a train of cog-wheels, so geared that the last wheel makes one revolution when the centre points of the cups have gone one mile.

Attached to this wheel is a crank bearing one end of a wooden or ratan rod, which passes down through the hollow iron rod bearing the vane; fastened to the lower end of the wooden rod is a small lever carrying a pencil, which makes a double mark about a half inch long crosswise of the paper, on the edge nearest the vane rod, corresponding to each revolution of the crank, or for every mile of distance travelled by the centre points of the cups.

The number of these double strokes (or curves, as they appear on the moving paper) in an hour's space, therefore, shows the number of miles travelled by the cups in that time.

Dr. Robinson assumed the proportion of the velocity of the cups to that of the wind to be as one to three, or the same as found in drawing a hemisphere through still water, first with its flat and then with its convex side forward; but, on account of the increased friction, I think the proportion in these machines cannot be less than as one to four or five, although their relation to the true velocity has not yet been tested.

I therefore call the velocity given in the table (which is that of the cups) the relative velocity, and in order to deduce from it the true velocity, it should be multiplied by four or five.

The records are taken from the sheets by passing them under a glass scale of the width of the hour spaces, graduated between the maxima and minima lines of the four cardinal points. By placing the centre of the scale over the hour-marks on the paper, the mean direction of the wind for the half hour preceding and the half hour following may be read, and the number of double strokes (or curves) seen underneath the scale will give the relative velocity per hour.

This anemograph was set up in the latter part of February, 1861, under the direction of Captain G. G. Meade, topographical engineer, but it did not get into working order until the first of April following, at which time the hourly records commence.

During the month of May the velocity cups were broken, and had to be taken off for repairs. They were replaced about the first of June, at which time the machine was taken down from a high tower, on which it was first placed, and removed to the observer's house for greater convenience, but with not so good an exposure.

The effect of this is apparent in the greater mean velocity of the wind during the month of April, and I have, therefore, omitted this month in many of my calculations.

To find the mean direction of the wind, for a month or year, we must first find the sums of all the winds that have blown during that time from the different points of the compass. This has been done for each month, according to the form shown in table M.

The velocity numbers are taken from the hourly records, in table L, and placed in their appropriate columns corresponding to the direction of the wind. The number of entries in these columns gives the number of hours the wind has blown from the several points of the compass, or the duration of the wind. The sum of each column gives the whole body of wind which has passed over the place from each point.

I call this the amount of the wind, as it is the product of the duration by the velocity.

In the last column are given the hours of calm.

In table N are placed the duration and amount, numbers, and the relative velocity found by dividing one by the other.

In place of interpolating for the hours omitted in the records, and for the purpose of comparing one month with another, I have reduced all the months to a mean month of 730 hours. These reductions will be found in the sixth and seventh columns of table N.

In tables O are given the observed duration, mean relative velocity, and the amount of wind for the several points for each month, and for the whole time; and in tables P the comparative duration and amount for the same time.

In tables Q are shown the mean comparative duration, and amount and mean relative velocity, for each season and for the year.

These quantities are graphically represented in the wind roses, diagrams 2–13. The shaded parts show the duration, &c., for the several points, being plotted from the outer towards the inner circle. It will be seen that in the earlier months the N.NE. and SE. winds prevail, and the W. and SW. in the latter.

In every month but December the greatest velocity is during the winds from the N.NE., and in that month from the E.SE. and SW.

The amount and velocity roses for the month of April cannot be compared with those of the other months, on account of the change in the position of the anemograph before mentioned.

The wind roses for the seasons and year need to be compared with those of subsequent years to draw any conclusion from them in regard to the prevalence of different winds.

RESULTANT DIRECTION AND VELOCITY.

Lambert's formula for finding the resultant direction of the wind is for only eight points, and does not take into account the velocity.

I modified it somewhat, as follows:

In Fig. 1, let A B represent the meridian A D, an east line, and A C the direction from which the wind we wish to reduce is blowing. This wind must be resolved into two forces, one N and one E, so by taking all the winds blowing around the point A during a certain time, and resolving into their resultant forces in the direction of the four cardinal points, they can be summed up and the resultant direction obtained. To do this we can use either the duration or amount of the wind. Then letting $a =$ the duration or amount of the wind, from a given point; $b =$ the angle made by that point with the meridian; $x =$ the resultant, north or south, and $y =$ the resultant east or west;

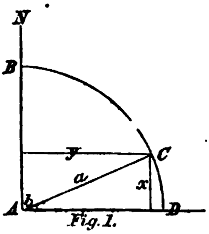


Fig. 1.

then we have
$$x = \frac{a \text{ cos. } b.}{\text{sine } 90^\circ} \quad a = \text{cos. } b.$$
$$y = \frac{a \text{ sine } b}{\text{sine } 90^\circ} = a \text{ sine } b.$$

Making $a = 1$, and b severally equal to the angle the first four points make with the meridian, we will have a series of constant multiples for the quantities in table N.

In table R are given the duration and amount thus reduced for the month of September.

The sums of the quantities in the duration and amount columns are then substituted in Lambert's formula; $\frac{\text{E}-\text{W}}{\text{N}-\text{S}} =$ the tangent of the angle made by the resultant directions of the wind with the meridian.

The proportionate part of the wind blowing in the resultant directions is found by multiplying the numerator of the fraction by the sine of the angle of the resultant direction, and dividing by the duration.

The resultant relative volocity is found by dividing the sum of all the amount columns by the sum of all the duration columns.

In table S is given the resultant direction, progress, (or proportionate part,) and relative velocity of the wind, computed from both the duration and amount for each month, and for the whole time.

In most of the months it will be noticed that the resultant direction computed from the duration and the amount differs but little, though in the month of September the difference is nearly sixty-two degrees.

In the early months of the year it will be seen that the resultant directions are from the north and northeast, and in the later months from the south and southwest, while that for the whole time is nearly west.

I have also given the resultant direction, omitting the month of April, which, as computed from the amount, differs not quite eleven degrees from that of the whole time, including that month.

I have called storms all those continuous winds whose relative velocity is four and one-half miles per hour and over, that being being nearly one-half the greatest relative velocity (9.2).

In table U are given the storms which occurred during the different months, and in table V the same grouped according to their directions.

Nearly one-half of the storms it will be seen come from the north to northeast, and about one-third from the southwest to west.

The greatest velocity was in June, with a southwest wind, and the longest storm was in November, with a southeast wind.

RAIN-FALL WITH DIFFERENT WINDS.

Tables W give the direction of the wind during the time of downfall of rain or snow at Milwaukee for the years 1861–'62–'63 and 1864.

The following table, compiled from the above, shows the number of times of rain or snow (amounting to more than 0.1 inch) when the wind blew from sixteen points of the compass, and the proportionate amount of downfall for each point during the four years:

Points.	No. of times of downfall.	Amount of downfall in U.S. inches.	Proportionate amount of downfall.
North	2	0.91	0.45
North-northeast	22	12.32	0.56
Northeast	28	16.81	0.60
East-northeast	7	4.63	0.60
East	3	2.32	0.16
East-southeast	13	8.07	0.61
Southeast	26	10.98	0.42
South-southeast	10	7.07	0.71
South	8	4.61	0.58
South-southwest	15	7.52	0.50
Southwest	29	11.87	0.41
West-southwest	8	2.14	0.27
West	4	2.04	0.51
West-northwest	6	1.48	0.25
Northwest	11	5.90	0.54
North-northwest	6	2.28	0.38
Calm	16	7.29	0.46

From this it will be seen that though rain fell about the same number of times when the wind blew from the northeast, southeast, and southwest, yet the amount of rain was nearly half as much again with a northeast wind as with the wind from the other points, and that nearly one-third of the whole amount of downfall occurred when the wind was north northeast to northeast.

The least amount of downfall was when the wind blew from the cardinal points. This may be partly accounted for by the fact, as shown by all the anemograph records, that the wind blows more seldom from those points than from any other of the compass.

COMPARISON OF HUMIDITY, EVAPORATION, TEMPERATURE, ETC.

For the purpose of showing the relation between the humidity, evaporation, temperature, cloudiness, and the direction and velocity of the wind, I have given in table X their several daily means for the summer months of the years 1862, 1863, and 1864 at Milwaukee, Wisconsin, and in table Y have eliminated the quantities separately and found the proportionate value of the others for each year.

Table Z is a summation of the last for the three years taken.

Thus we have in the last mentioned tables, first, the mean value of the temperature, humidity, &c., for the direction of the wind, and the number of days observed; second, the mean value of the several States corresponding to the different velocities of the wind; and so on.

Looking at the final table, Z, it will be seen that we have the highest temperature with a wind from the south-southwest to west, and the lowest with one from the north to north-northeast; the greatest velocity of the wind from the north to northeast, the least from the east to southeast.

The direction of the wind seems, however, to have but little effect on the evaporation and humidity.

Again, we have the highest temperature when the relative velocity of the wind is from 0.5 to 1.0, and the least when it is blowing the strongest. The humidity is not regularly and the evaporation but slightly affected by its increase.

Thirdly, the temperature is seen to be but little effected by the changes in the amount of humidity in the atmosphere, but the evaporation and cloudiness are almost in an inverse proportion to its increase.

Fourthly, the cloudiness does not show much effect on the temperature except when the sky is overcast, but the evaporation decreases and the humidity increases as we pass from a clear to a clouded sky.

Fifthly, the humidity decreases slightly and the evaporation increases with a rise of temperature, and the sky becomes somewhat more clouded and the wind less strong.

Sixthly, the elimination of the evaporation but reasserts the foregoing; with its increase the temperature rises and the humidity and evaporation decrease.

Most of the above facts might seem to be so plain as to need no proof, but it is interesting to be able to demonstrate them. and some of them are rather curious; for instance, the slight effect the velocity of the wind has upon the humidity and evaporation, and also the effect of the cloudiness upon the temperature.

ATMOSPHERICAL PRESSURE UPON THE WATER.

The effect of the atmospheric pressure upon the surface of the water is shown in tables A A, where the mean height of the water for every six hours from Saxton's self-registering tide guage, the mean relative velocity and direction of the wind for every six hours from Burnell's anemograph, and the tri-daily observations of the barometer and thermometer from the general meteorological abstract, are given for the years 1861–'62–'63 and '64 at Milwaukee, Wisconsin. These tables are graphically represented in diagrams 14—21.

Milwaukee, as will be seen by a reference to the description of the stations, is situated on a small bay on the west side of Lake Michigan, south of the centre and opposite the broadest part of the lake. It is protected by low hills from the full effect of the winds from the south to north by west, but exposed to those from other quarters. The effect of easterly winds is to raise the water in the bay, and of westerly winds to depress it. Northerly winds will raise and southerly winds will lower the level of the water in the whole lake after they have blown for some time. Therefore the water in a southeast wind will be first raised by the easterly and afterward lowered by the southerly tendency, while a northeast wind will raise the water continually. In southwest and northwest winds this action is reversed. In some cases however the first effect of a northeast wind is to blow the water away from the mouth of the bay, and thus, for a short time, to lower it. These facts must be taken into consideration before we can intelligently examine the diagrams to find the effects of atmospheric pressure. In many cases in the diagrams the water will rise or fall contrary to the influence exerted by the winds. It will then be seen that the barometer curve is opposed to the water curve, and that the direct pressure of the air is greater than that of the air in motion. And when the wind is strong enough to raise or lower the water, contrary to the weight of air, the rapidity with which it returns to its equilibrium shows the effect of the pressure upon it. The maximum rise in the water will occur when a strong easterly wind is blowing at the time of a low barometer, and the minimum when a westerly wind and a high barometer are simultaneous. These facts show that the atmospheric pressure on the water of the lakes is the same, though in a less degree, as that often seen on the coast of South America during the great fall of the barometer before a hurricane, and also why the fishermen along the coast can often predict the approach of storms by the rise or fall of the water. In order not to confuse the diagrams the temperature curves were omitted.

LAND AND LAKE BREEZE.

To ascertain whether we have upon the lakes a land and lake breeze similar to the land and sea breezes on the ocean, I have compiled from the hourly anemograph records at Milwaukee and Cleveland and from the half-hourly observations at Thunder Bay island tables B B. In these tables the number of days are given in which the wind blew from the different points of the compass during the several hours in the months of June, July and August, all stormy and cloudy days being first thrown out.

A summation of these tables for each place is given in tables C C, and the latter are graphically represented in the diagrams 22 and 25, according to the principle of indexed planes used by M. Koeuptz in his meteorology, in which the curves represent the outlines of planes passing through every fifth number in the tables, the larger number being taken as hills and the lesser as valleys.

Diagram 22, for Milwaukee for four years, shows a decided breeze off the lake from the east-southeast and southeast from 10 or 11 o'clock a. m. till 6 or 7 o'clock p. m.; from noon till 5 p. m. on nearly one-half of the days taken, the wind blew from these two points. This would be from the broadest part of the lake.

The land breeze is not as well marked, its effect being probably diminished by the hills back of Milwaukee.

In diagrams 23, for Cleveland, on the other hand, we have but little indication of a lake breeze, but have a land breeze from 9 o'clock in the evening till 9 o'clock in the morning.

The Cleveland anemograph being on a high tower upon the bluff overlooking the lake, the lake breeze rarely rises high enough to effect it, while it feels the full influence of all winds off land.

There is, however, but one year's observations here, as the anemograph broke down and has never been replaced.

Diagram 24, being very curiously banded, I reduced the number of points used to eight and replotted it in diagram 25.

This banding shows the difference between a careful observer and a machine, the observer having only recorded the wind as blowing from the eight principal points.

The latter diagram shows a breeze from the south and southeast, in which direction the main body of the lake lies, and from the north from 10 a. m. to 10 p. m., and from the north and northwest from midnight to 8 a. m.

The island lying a distance from land, and having a large body of water around it from north to south by east, the lake breeze assumes a rotary character opposed to the apparent motion of the sun, and the land breeze much weakened in its effect. This was also shown in diagram 1 to be true for all the seasons as well as for the summer months we are now investigating. The island is not large enough to have a land breeze of its own, and only received a part of that from the mainland.

Whether this lake breeze blows from the centre of the lake towards each shore, is a question we have not the means at present of investigating, but hope to have at some future time.

The last lines in the tables give the number of days taken in each month and season and the number of hours of calm.

In tables C C it will be seen that the calmest hours were from 10 o'clock at night to 4 o'clock in the morning at Milwaukee, and at Thunder Bay island from 8 o'clock in the evening till midnight, while at Cleveland the most windy hours were from 10 at night to 3 in the morning, which is a confirmation of the supposition that the day breeze does not reach the elevation of the observatory.

The records of the levels of the water at the several stations have not been reduced since 1863, nor have I been able to give enough attention to them to report upon them this year.

I hope another year to be able to bring them up.

Very respectfully, your obedient servant,

D F. HENRY,
Assistant Lake Survey.

General W. F. RAYNOLDS,
Corps of Engineers, Sup't Lake Survey, Detroit.

Reductions of the monthly meteorological register of the survey of

Date.	Barometer reduced to temperature of 32° Fahr., expressed in United States inches and decimals.				TEMPERATURE—FAHRENHEIT.									VAPOR.			
					Wet bulb, or point of evaporation.			Dry bulb, or temperature of the open air.				Maximum.	Minimum.	Elasticity, in U. S. inches and decimals.			
	7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	Mean.			7 a. m.	2 p. m.	9 p. m.	Mean.
1866.					°	°	°	°	°	°	°	°	°				
July 1	29.262	29.228	29.259	29.250	54	60	54	55	63	56	58.0	65	50	.404	.478	.391	.424
2	29.257	29.155	29.112	29.175	57	72	64	59	80	68	69.0	82	50	.439	.677	.543	.553
3	28.923	28.914	28.960	28.932	62	67	60	64	79	67	70.0	81	59	.529	.635	.425	.530
4	28.960	28.952	28.970	28.961	63	69	65	66	86	71	74.3	88	55	.536	.480	.537	.518
5	28.917	28.958	28.999	28.958	69	53	49	73	55	51	59.7	70	50	.655	.376	.521	.451
6	29.018	29.051	29.085	29.051	49	51	61	50	52	63	55.0	65	48	.335	.361	.510	.402
7	29.146	29.203	29.219	29.189	62	64	58	63	74	60	65.7	77	55	.542	.462	.456	.467
8	29.502	29.534	29.546	29.527	58	60	57	60	65	60	61.7	67	50	.456	.451	.426	.444
9	29.610	29.532	29.472	29.538	54	60	53	55	62	54	57.0	66	50	.404	.491	.389	.428
10	29.430	....	29.339	29.385	59	....	68	60	....	76	68.0	89	43	.487	....	.577	.522
11	29.330	29.256	29.241	29.276	70	73	74	74	91	82	82.3	94	65	.679	.569	.731	.526
12	29.282	29.218	29.243	29.248	75	80	76	80	98	87	88.3	99	75	.800	.779	.748	.776
13	29.286	29.213	29.125	29.208	63	69	68	64	71	69	68.0	87	59	.562	.682	.671	.605
14	29.218	29.176	29.120	29.171	60	60	58	61	62	59	60.7	70	55	.505	.491	.469	.488
15	29.141	29.122	29.255	29.173	63	80	66	65	90	67	74.0	90	56	.549	.897	.626	.691
16	29.225	29.251	29.754	29.410	69	79	65	70	89	75	78.0	89	65	.695	.855	.483	.678
17	29.468	29.435	29.431	29.445	66	67	62	67	71	64	67.3	76	64	.626	.608	.529	.588
18	29.421	29.378	29.365	29.388	63	68	72	65	76	75	72.0	81	52	.549	.577	.744	.623
19	29.384	29.205	29.300	29.296	62	73	63	63	75	65	67.7	81	55	.542	.784	.549	.625
20	29.311	29.220	29.205	29.245	65	71	65	67	82	67	75.3	83	54	.591	.610	.591	.597
21	29.131	29.206	29.234	29.190	59	58	59	60	60	60	60.0	68	55	.487	.456	.487	.477
22	29.199	29.235	29.276	29.237	63	68	55	64	70	56	63.3	74	55	.562	.658	.420	.547
23	29.302	29.306	29.274	29.294	53	57	54	54	58	55	55.7	60	52	.389	.452	.404	.415
24	29.294	29.302	29.325	29.306	58	75	67	59	86	76	73.7	89	48	.469	.719	.514	.567
25	29.411	29.392	29.504	29.436	63	58	58	65	60	60	61.7	74	60	.549	.456	.456	.487
26	29.406	29.336	29.356	29.366	59	64	66	60	68	67	65.0	68	62	.487	.543	.626	.552
27	29.348	29.302	29.338	29.329	65	79	63	69	86	64	73.0	91	58	.561	.895	.562	.674
28	29.396	29.310	29.290	29.332	67	77	68	68	78	70	72.0	80	58	.648	.914	.658	.740
29	29.268	....	29.301	29.285	68	....	63	70	....	64	67.0	90	60	.658	....	.562	.610
30	29.316	29.314	29.231	29.287	61	63	61	62	66	62	63.3	68	60	.523	.536	.523	.527
31	28.981	29.012	29.007	29.000	61	70	65	62	75	67	68.0	80	56	.523	.666	.591	.593
Means....	29.263	29.232	29.263	29.254	....	....	....	63.4	70.9	65.7	67.6	....	....	.543	.605	.533	.552
August 1	29.135	29.231	29.326	29.231	60	68	65	63	72	68	67.7	73	58	.478	.631	.577	.529
2	29.367	29.355	29.315	29.346	58	70	65	60	76	68	68.0	78	48	.456	.652	.577	.562
3	29.336	29.341	29.489	29.389	66	63	57	68	64	58	63.3	75	56	.612	.562	.452	.542
4	29.522	29.604	29.584	29.570	58	65	55	60	67	56	61.0	67	43	.456	.591	.420	.489
5	29.597	29.578	29.584	29.586	58	60	60	60	65	61	62.0	67	48	.456	.451	.505	.471
6	29.479	29.438	29.406	29.441	60	62	60	61	63	61	61.7	64	58	.505	.542	.505	.517
7	29.379	29.369	29.342	29.363	59	59	58	60	60	59	59.7	62	58	.487	.487	.469	.481
8	29.317	29.271	29.268	29.285	59	63	60	60	65	61	62.0	68	55	.487	.549	.505	.514
9	29.294	29.278	29.306	29.293	59	75	60	60	81	61	67.3	81	50	.487	.787	.505	.593
10	29.336	29.308	29.319	29.321	56	60	55	57	61	56	58.0	63	55	.436	.505	.420	.454
11	29.304	29.279	29.252	29.278	56	58	58	57	60	59	58.7	60	54	.436	.456	.469	.454
12	29.242	29.276	29.299	29.272	59	60	58	60	61	61	60.3	62	55	.487	.505	.456	.483
13	29.319	29.250	29.230	29.266	59	75	72	60	82	74	72.0	84	55	.487	.773	.757	.672
14	29.354	29.422	29.498	29.425	67	72	63	68	82	65	71.7	83	62	.648	.650	.549	.616
15	29.650	29.617	29.612	29.626	57	60	56	58	62	57	59.0	67	55	.452	.491	.436	.460
16	29.512	29.468	29.423	29.468	59	65	64	60	67	70	65.7	79	51	.487	.591	.516	.531
17	29.448	29.438	29.441	29.442	63	73	63	65	77	67	69.7	80	55	.549	.757	.522	.609
18	29.454	29.421	29.391	29.422	53	70	63	55	73	64	64.0	75	48	.376	.693	.562	.544
19	29.442	29.361	29.318	29.374	57	61	58	58	73	63	64.7	73	54	.452	.510	.416	.459
20	29.300	29.264	29.279	29.281	54	64	57	56	67	62	61.7	70	52	.391	.556	.399	.449
21	29.330	29.332	29.391	28.351	51	52	47	54	59	49	57.3	63	48	.335	.296	.297	.309
22	29.295	29.345	29.372	29.337	45	51	46	46	52	47	48.3	56	39	.286	.361	.297	.315
23	29.415	29.362	29.365	29.381	47	54	50	49	56	52	52.3	60	40	.297	.391	.334	.341
24	29.383	29.354	29.362	29.366	48	56	47	50	63	49	54.0	64	44	.309	.356	.297	.321
25	29.373	29.233	29.227	29.278	38	61	58	40	75	62	59.0	78	39	.203	.483	.429	.372
26	29.031	39.032	29.108	29.057	55	70	55	58	76	56	63.3	80	53	.393	.652	.420	.488
27	29.208	29.234	29.234	29.225	54	58	54	56	60	56	57.3	62	52	.391	.456	.391	.413
28	29.237	29.236	29.256	29.243	52	65	57	54	70	59	61.0	75	43	.362	.550	.439	.450
29	29.272	29.232	29.227	29.244	54	60	55	56	62	56	58.0	62	54	.391	.491	.420	.434
30	29.212	29.178	29.153	29.181	54	56	57	56	58	58	57.3	60	54	.391	.422	.452	.422
31	29.006	28.961	28.891	28.953	54	55	56	55	56	57	56.0	59	52	.404	.420	.436	.422
Means....	29.340	29.325	29.331	29.332	....	....	....	57.4	66.6	59.7	61.2	....	....	.432	.536	.459	.476

the northern and northwestern lakes at Superior City, Wisconsin.

VAPOR.				WIND.								Amount of cloudiness. (0 = clear sky.) (10 = sky entirely overcast.)			Amount of evaporation, in U. S. inches and decimals.	Amount of rain or melted snow, in U. S. inches and decimals.
Humidity. Saturation = 1,000.				Direction. From whence.			Velocity, in miles, per hour.			Resultant velocity, in miles, per hour.	Resultant direction.					
7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.			7 a. m.	2 p. m.	9 p. m.		
											°					
.934	.831	.872	.879	NE ...	NE ...	NE ...	1.0	2.0	1.0	1.3	N. 45 E .	7	5	8	......	......
.878	.661	.793	.777	NE ...	NW ...	NW ...	1.0	2.0	0.6	1.0	N. 21 W.	6	4	3	......	......
.888	.896	.642	.809	NW ...	NW ...	NW ...	1.0	8.4	2.0	3.3	N. 45 W.	10	3	2	......	......
.838	.387	.708	.644	NW ...	NW ...	Calm ..	1.6	2.8	0	1.3	N. 45 W.	0	4	10	......	......
.807	.869	.859	.845	NW ...	NE ...	NE ...	1.0	6.0	3.0	3.0	N. 39 E .	2	0	8	......	.12
.927	.930	.886	.914	NE ...	NE ...	NW ...	2.0	1.0	0.6	1.0	N. 34 E .	10	10	6	......	.02
.942	.551	.880	.791	NW ...	NW ...	NW ...	1.0	5.4	1.0	2.6	N. 45 W.	0	6	3	......	.06
.880	.731	.822	.811	NW ...	NE ...	N	0.6	1.6	0.6	1.0	N. 12 E .	0	3	0	......	......
.934	.884	.933	.917	NE....	NE ...	NE ...	2.0	3.6	0.6	2.0	N. 45 E	0	0	3	......	......
.940	......	.644	.762	Calm ..	....	S	0	...	1.0	0.3	South . .	0	....	0	......	......
.810	.391	.669	.623	NW ...	SW ...	SW ...	2.0	8.4	4.2	4.3	S. 53 W.	0	0	6	......	......
.782	.432	.584	.599	SW ...	SW ...	SW ...	6.0	4.2	2.0	4.0	S. 45 W.	0	3	2	......	......
.943	.899	.947	.930	N.NW.	NE ...	NE ...	2.0	3.6	2.4	2.3	N. 31 E	10	5	10	......	.54
.941	.884	.939	.921	NE....	NE ...	NE ...	1.0	1.6	0.6	1.0	N. 45 E .	8	8	10	......	1.30
.890	.639	.946	.822	SW ...	SW ...	NE ...	2.1	1.0	2.0	0.3	S. 45 W.	8	7	10	......	......
.948	.626	.558	.711	NW ...	NW ...	NW ...	1.0	3.6	1.0	1.7	N. 45 W.	0	3	3	......	1.71
.946	.802	.888	.879	Calm ..	NE ...	NE ...	0	2.0	0.6	0.7	N. 45 E	9	10.	2	......	......
.890	.644	.858	.797	NW ...	NW ...	Calm ..	0.6	1.1	0	0.6	N. 45 W.	0	3	2	......	......
.942	.904	.890	.912	NE....	NE ...	Calm ..	1.0	1.0	0	0.7	N. 45 E .	6	3	2	......	......
.893	.559	.893	.782	Calm ..	SW ...	Calm ..	0	3.6	0	1.3	S. 45 W	0	3	4	......	......
.940	.880	.940	.920	NE ...	NE ...	Calm ..	5.4	3.6	0	3.0	N. 45 E	10	10	10	......	.66
.943	.898	.935	.925	Calm ..	NE ...	NE ...	0	3.0	15.4	6.0	N. 45 E .	6	7	10	......	......
.933	.937	.934	.935	NE ...	NE ...	Calm ..	8.4	3.6	0	2.3	N. 45 E .	10	10	4	......	......
.939	.579	.537	.685	SW ...	SW ...	SW ...	0.6	2.0	0.6	1.0	S. 45 W.	10	3	0	......	......
.890	.880	.880	.883	NE ...	NE ...	NE ...	1.0	3.0	1.0	1.7	N. 45 E .	0	6	8	......	......
.940	.793	.946	.893	NE ...	NE ...	NE ...	2.0	3.0	1.0	2.0	N. 45 E .	8	3	4	......	......
.796	.721	.943	.820	NW ...	NW ...	NE ..	1.0	2.0	1.0	1.0	N. 28 W.	0	3	4	......	......
.947	.954	.898	.933	NE ...	NE ...	Calm ..	0.6	1.0	0	0.7	N. 45 E .	10	2	3	......	......
.898	......	.943	.921	NW ...	....	NE ...	1.0	...	2.0	1.0	N. 45 E .	0	....	4	......	......
.942	.838	.942	.907	NE ...	NE ...	NE ...	2.0	1.0	1.6	1.6	N 45 E .	10	8	10	......	......
.942	.768	.893	.868	Calm ..	NW ...	NW ...	0	8.4	1.0	3.0	N. 45 W.	10	5	6	......	.06
.906	.750	.836	.833	....	....	....	....	....	....	2.7	N. 5 E ..	4.8	4.8	4.9	......	4.47
.831	.804	.843	.826	NW ...	NW ...	NW ...	8.4	6.0	0.6	5.0	N. 45 W.	3	5	0	......	......
.880	.727	.843	.817	SW ...	SW ...	SW ...	2.0	3.0	1.0	2.0	S. 45 W.	6	4	5	......	......
.895	.943	.937	.925	SW ...	NE ...	NE ...	1.0	2.0	1.6	0.7	N. 45 E	3	8	6	......	......
.880	.893	.935	.903	NE ..	NE ...	NE ...	1.0	1.2	0.6	0.8	N. 45 E .	0	6	8	......	......
.880	.731	.941	.851	SW ...	SW ...	Calm ..	0.6	0.3	0	0.3	S. 45 W.	7	8	10	......	......
.941	.942	.941	.941	NE ...	NE ...	NE ...	1.0	4.2	5.4	3.4	N. 45 E .	10	10	10	......	.12
.940	.940	.939	.940	NE ...	NE ...	NE ...	4.0	6.0	2.0	4.0	N. 45 E .	10	10	10	......	......
.940	.890	.941	.924	NE ...	NE ...	NE ...	2.0	1.0	4.2	2.3	N. 45 E .	10	3	5	......	.34
.940	.744	.941	.875	NE ...	NE ...	NE ...	1.0	1.0	3.6	1.9	N. 45 E .	0	2	8	......	......
.946	.941	.935	.937	NE ...	NE ...	NE ...	3.0	1.0	0.6	1.5	N. 45 E .	10	10	10	......	......
.936	.880	.939	.918	NE ...	NE ...	NE ...	2.0	3.0	6.0	3.7	N. 45 E .	10	10	10	......	......
.940	.941	.880	.987	NE ...	NE ...	NE ...	1.0	2.0	2.4	1.8	N. 45 E .	10	10	10	......	.32
.940	.708	.903	.850	NE ...	SW ...	SW ...	0.6	2.0	0.6	0.7	S. 45 W.	10	3	10	......	......
.947	.595	.890	.811	N	NW ...	Calm ..	4.5	2.4	0	2.3	N. 14 W.	2	4	0	......	......
.937	.884	.936	.919	NE ...	NE ...	NE ...	4.2	6.0	5.4	5.1	N. 45 E .	10	3	0	......	......
.940	.893	.704	.846	NE ...	NE ...	Calm ..	2.0	1.0	0	1.0	N. 45 E .	4	5	0	......	......
.890	.817	.790	.832	NW ...	NW ...	NE ...	1.6	0.6	2.0	1.0	N. 11 W.	0	6	4	......	......
.869	.854	.943	.889	NW ...	NE ...	NE ...	0.6	1.0	0.9	0.7	N. 27 E .	0	3	10	......	......
.937	.886	.723	.849	NW ...	NW ...	NW ...	0.6	2.0	0.6	1.1	N. 45 W.	0	4	3	......	......
.872	.841	.718	.810	NW ...	NW ..	NW ...	3.0	4.2	1.0	2.7	N. 45 W.	0	3	2	......	......
.802	.592	.853	.749	NW ..	NW ...	Calm ..	3.6	2.0	0	1.9	N. 45 W.	4	3	0	......	......
.921	.930	.923	.925	Calm ..	NE ...	Calm ..	0	2.4	0	8.0	N. 45 E .	8	6	4	......	.63
.853	.872	.861	.862	NW ...	NW ...	NW ...	1.0	3.0	0.6	1.5	N. 45 W.	0	8	5	......	......
.856	.619	.853	.776	NW ...	NW ...	Calm ..	1.0	0.9	0	0.6	N. 45 W.	6	4	0	......	......
.820	.783	.772	.758	SW ...	SW ...	Calm ..	1.0	6.0	0	2.3	S. 45 W.	0	0	0	......	......
.816	.727	.935	.826	SW ...	NE ...	NE ...	3.0	1.0	8.4	2.1	N. 45 E .	4	3	10	......	.38
.872	.880	.872	.875	NE ...	NE ...	NE ...	3.6	2.0	3.0	2.9	N. 45 E .	3	0	3	......	......
.867	.751	.878	.832	NE ...	NW ...	NW ...	0.3	4.2	6.0	3.3	N. 44 W.	0	2	0	......	......
.872	.884	.935	.897	NW ...	NE ...	NE ...	2.0	1.6	4.2	2.0	N. 26 E	8	3	10	......	......
.872	.876	.937	.895	NE ...	NE ...	NE ...	1.6	5.4	7.2	4.7	N. 45 E .	6	5	7	......	.12
.934	.935	.936	.935	NE ...	NE ...	NE ...	15.4	20.0	5.4	1.4	N. 45 E .	10	10	10	......	......
.895	.829	.883	.869	....	....	....	....	....	....	1.7	N. 23 E .	4.9	5.2	5.5	......	1.31

Reductions of the monthly meteorological register of the survey of

Date.	Barometer reduced to temperature of 32° Fahr., expressed in United States inches and decimals.				TEMPERATURE—FAHRENHEIT.									VAPOR.			
					Wet bulb, or point of evaporation.			Dry bulb, or temperature of the open air.				Maximum.	Minimum.	Elasticity, in U.S. inches and decimals.			
	7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	Mean.			7 a. m.	2 p. m.	9 p. m.	Mean.
1866.					°	°	°	°	°	°	°	°	°				
Sept. 1	28.958	28.963	29.013	28.978	54	60	60	56	70	62	62.7	70	54	.391	.385	.491	.422
2	29.083	29.110	29.164	29.119	54	58	58	56	71	60	62.3	73	50	.391	.443	.456	.430
3	29.247	29.228	29.251	29.242	50	60	56	53	73	62	62.7	75	47	.391	.345	.369	.345
4	29.210	29.222	29.219	29.217	52	57	52	53	58	53	54.7	63	50	.375	.542	.375	.401
5	29.237	29.258	29.311	29.269	52	62	54	53	67	56	58.7	70	44	.375	.489	.391	.418
6	29.322	....	29.280	29.301	53	....	53	55	....	54	54.5	60	46	.376	.....	.389	.382
7	29.247	29.196	29.247	29.230	52	60	49	53	62	50	55.0	63	50	.375	.491	.335	.400
8	29.363	29.404	29.487	29.418	49	58	49	50	62	51	54.3	63	43	.335	.429	.321	.362
9	29.563	29.522	29.494	29.526	47	59	52	48	64	54	55.3	66	38	.310	.433	.361	.368
10	29.441	29.346	29.264	29.350	46	60	50	47	66	52	55.0	69	40	.297	.438	.334	.356
11	29.099	28.982	28.881	28.987	46	61	58	47	65	59	57.0	68	40	.297	.483	.469	.416
12	28.881	28.974	29.098	28.984	49	55	51	50	62	52	54.7	63	50	.335	.340	.361	.345
13	29.259	29.242	29.225	29.242	42	53	54	43	58	56	52.3	62	39	.254	.336	.391	.327
14	29.453	29.453	29.450	29.452	42	48	39	43	55	40	46.0	56	39	.254	.243	.225	.241
15	29.426	29.264	29.207	29.299	38	58	50	40	65	51	52.0	67	29	.203	.389	.348	.313
16	29.280	29.350	29.425	29.352	43	53	40	44	55	41	46.7	56	40	.264	.376	.235	.292
17	29.482	29.415	29.383	29.427	36	53	45	37	54	46	45.7	55	32	.199	.389	.286	.291
18	29.392	29.343	29.385	29.373	37	47	40	38	54	41	44.3	55	30	.207	.231	.235	.224
19	29.494	29.505	29.526	29.508	42	46	43	43	52	45	46.7	53	35	.254	.232	.251	.246
20	29.571	29.518	29.425	29.505	40	47	34	41	48	35	41.3	49	35	.235	.310	.183	.243
21	29.510	29.456	29.418	29.461	33	48	43	34	50	45	43.0	51	23	.175	.309	.251	.245
22	29.188	29.151	29.187	29.175	42	52	49	43	54	50	49.0	55	40	.254	.362	.335	.317
23	29.219	29.186	29.200	29.202	47	50	51	48	51	52	50.3	53	45	.310	.348	.361	.340
24	28.941	29.038	29.285	29.088	49	54	40	50	56	43	49.7	56	40	.335	.391	.208	.311
25	29.338	29.294	29.274	29.302	42	55	53	43	65	56	54.7	66	35	.254	.300	.363	.306
26	29.250	29.363	29.374	29.329	45	58	48	48	70	50	56.0	74	45	.260	.323	.309	.297
27	29.380	29.377	29.282	29.346	50	56	47	52	60	48	53.3	60	43	.334	.396	.310	.347
28	29.250	29.198	29.240	29.229	51	56	58	53	61	59	57.7	61	43	.348	.443	.469	.420
29	29.555	29.637	29.535	29.576	56	58	42	58	60	54	57.3	66	43	.422	.456	.110	.329
30	29.563	29.427	29.402	29.464	45	57	48	48	60	51	53.0	62	31	.260	.426	.296	.327
Means....	29.307	29.261	29.298	29.298	....	....	....	47.6	58.3	50.9	52.3	....	....	.300	.366	.327	.335
Oct. 1	29.206	29.135	29.162	29.168	52	65	55	54	80	60	64.7	80	40	.362	.417	.367	.382
2	29.463	29.447	29.470	29.460	42	56	48	45	64	50	53.0	64	42	.228	.343	.309	.293
3	29.423	29.390	29.485	29.433	38	53	48	40	55	50	48.3	60	35	.203	.376	.309	.296
4	29.603	29.568	29.575	29.582	40	50	45	43	52	47	47.3	57	37	.208	.334	.273	.272
5	29.553	29.460	29.440	29.484	42	54	48	44	55	50	49.7	57	40	.241	.404	.309	.318
6	29.358	29.261	29.286	29.302	40	68	58	43	81	62	62.0	82	38	.208	.510	.429	.382
7	29.287	29.150	29.153	29.197	57	69	54	58	84	56	66.0	84	54	.452	.507	.391	.450
8	29.148	29.108	29.109	29.122	48	50	47	51	52	48	50.3	64	45	.296	.334	.310	.313
9	29.258	29.310	29.375	29.314	47	54	43	48	56	44	49.3	60	44	.310	.391	.264	.322
10	29.450	29.517	29.543	29.503	40	52	39	41	56	40	45.7	60	39	.235	.335	.225	.265
11	29.512	29.464	29.383	29.453	31	50	48	32	52	50	44.7	52	29	.162	.334	.309	.268
12	29.453	29.301	29.257	29.337	46	53	50	47	54	52	51.0	57	40	.297	.389	.334	.340
13	29.321	29.322	29.372	29.338	41	54	55	42	56	56	51.3	57	36	.244	.391	.420	.318
14	29.593	29.580	29.618	29.597	45	55	50	46	56	51	51.0	57	35	.289	.420	.348	.355
15	29.783	29.805	29.817	29.802	49	53	46	50	54	47	50.3	56	45	.335	.389	.297	.340
16	29.791	29.652	29.599	29.681	42	62	50	43	74	56	57.7	74	40	.254	.396	.282	.311
17	29.465	29.285	29.197	29.316	47	55	50	48	57	51	52.0	64	40	.310	.407	.348	.355
18	28.882	28.881	29.001	28.921	50	52	43	54	53	44	50.3	61	43	.308	.375	.264	.316
19	29.165	29.196	29.213	29.191	34	58	38	35	61	39	45.0	61	33	.183	.443	.216	.281
20	29.228	29.152	29.127	29.169	46	46	46	47	47	47	47.0	50	35	.297	.297	.297	.297
21	28.902	28.810	28.786	28.833	42	42	35	43	43	36	40.7	48	35	.254	.254	.191	.233
22	28.703	28.692	28.945	28.780	34	36	29	35	37	30	34.0	40	30	.183	.199	.149	.177
23	29.230	29.453	29.542	29.408	29	31	29	30	32	30	30.7	34	28	.149	.162	.149	.153
24	29.543	29.407	29.395	29.448	28	31	28	29	32	29	30.0	33	25	.142	.162	.142	.149
25	29.283	29.207	29.210	29.233	32	34	32	33	35	33	33.7	35	26	.168	.183	.168	.173
26	29.250	29.286	29.336	29.291	32	34	32	33	35	33	33.7	36	30	.168	.183	.183	.178
27	29.478	29.372	29.299	29.383	31	35	....	32	37	....	34.5	....	....	.162	.178	....	.170
28	29.000	29.072	29.172	29.081	39	38	34	40	39	35	38.0	40	29	.225	.216	.183	.208
29	29.200	29.105	29.175	29.160	32	34	33	33	35	34	33.7	37	30	.168	.183	.175	.175
30	29.455	29.524	29.587	29.522	30	32	22	31	33	23	29.0	36	22	.155	.168	.107	.143
31	29.536	29.330	29.188	29.351	17	31	28	18	32	29	26.3	32	15	.083	.162	.142	.129
Means....	29.339	29.298	29.317	29.318	....	....	....	40.9	51.2	42.3	44.8	....	....	.234	.317	.263	.271

the northern and northwestern lakes at Superior City, Wisconsin.

VAPOR.				WIND.								Amount of cloudiness. (0 = clear sky.) (10 = sky entirely overcast.)			Amount of evaporation, in U. S. inches and decimals.	Amount of rain or melted snow, in U. S. inches and decimals.
Humidity. Saturation = 1,000.				Direction. From whence.			Velocity, in miles, per hour.			Resultant velocity, in miles, per hour.	Resultant direction.					
7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.			7 a. m.	2 p. m.	9 p. m.		
.872	.525	.884	.760	NW	NW	Calm	2.0	5.4	0	2.5	N. 45 W.	0	0	10	......	.42
.872	.825	.880	.859	NW	NW	Calm	3.6	6.0	0	3.2	N. 45 W.	0	3	4	......	......
.798	.425	.665	.629	NW	NW	NW	4.2	3.6	2.4	3.3	N. 45 W.	3	4	7	......	......
.932	.937	.932	.934	NE	NE	NW	2.0	1.6	0.6	1.3	N. 44 E.	10	5	10	......	.64
.932	.740	.872	.848	NW	NW	Calm	1.6	3.6	0	1.7	N. 45 W.	0	3	7	......	.13
.869	......	.933	.901	NW	....	NE	1.0	....	2.0	1.0	N. 45 E.	0	....	8	......	.03
.932	.884	.927	.914	NE	NE	NE	1.0	1.9	1.0	1.3	N. 45 E.	7	4	5	......	.80
.927	.772	.859	.853	NW	NW	NW	1.0	1.2	0.6	0.9	N. 45 W.	3	5	2	......	.10
.925	.727	.867	.840	Calm	SE	Calm	0	1.0	0	0.3	S. 45 E.	4	3	5	......	......
.923	.685	.861	.823	Calm	NE	Calm	0	1.0	0	0.3	N, 45 E.	0	2	0	......	......
.923	.783	.939	.882	E	NE	NE	1.9	1.0	0.3	1.0	N. 73 E.	8	7	6	......	......
.927	.612	.930	.823	NW	NW	NW	6.0	12.0	2.0	6.6	N. 45 W.	5	4	2	......	......
.916	.698	.872	.829	NW	NE	NW	0.3	0.6	1.0	0.7	N. 14 W.	6	7	9	......	......
.916	.561	.910	.796	NW	NW	NW	4.2	6.0	0.3	3.4	N. 45 W.	5	4	0	......	......
.820	.631	.929	.793	NW	SW	SW	1.0	8.4	6.0	4.7	S. 48 W.	0	5	10	......	......
.918	.869	.912	.900	NW	NW	Calm	4.2	9.6	0	4.7	N. 45 W.	8	6	0	......	.10
.903	.933	.921	.919	NW	NW	Calm	0.6	7.2	0	2.6	N. 45 W.	8	5	0	......	......
.905	.552	.912	.790	Calm	Calm	Calm	0	0	0	0	Calm	0	6	7	......	......
.916	.598	.840	.785	NE	NE	NE	0.6	1.0	0.3	0.7	N. 45 E.	8	7	10	......	......
.912	.925	.898	.912	NW	NE	Calm	3.0	1.0	0	1.0	N. 28 W.	10	5	0	......	......
.895	.856	.840	.864	Calm	SE	NE	0	2.0	2.0	0.9	East	0	4	8	......	......
.916	.867	.927	.903	E	Calm	Calm	1.0	0	0	0.3	East	10	10	10	......	.16
.925	.929	.930	.928	NE	NE	NE	1.0	2.0	0.6	1.2	N. 45 E.	10	10	10	......	.64
.927	.872	.750	.850	NE	NW	NW	2.4	4.2	3.0	2.3	N. 28 W.	10	5	0	......	1.06
.916	.487	.809	.737	NW	SW	Calm	1.0	6.0	0	2.0	S. 54 W.	4	3	0	......	......
.777	.441	.856	.691	SW	SW	Calm	3.0	2.0	0	1.0	S. 79 W.	0	0	0	......	......
.861	.765	.925	.850	NE	NE	Calm	1.0	1.2	0	0.7	N. 45 E.	0	0	0	......	......
.864	.825	.939	.876	Calm	NE	Calm	0	1.6	0	0.5	N. 45 E.	0	0	0	......	......
.876	.880	.264	.673	NW	NE	Calm	1.0	2.0	0	1.0	N. 13 E.	0	0	0	......	......
.777	.822	.790	.796	Calm	NE	Calm	0	1.4	0	0.4	N. 45 E.	0	0	0	......	......
.892	.714	.859	.832	....	....	....	....	....	....	1.1	N. 40 W.	4.3	3.9	4.3	......	4.08
.867	.407	.708	.661	SW	SW	W	2.0	5.4	5.0	4.0	S. 65 W.	0	0	10	......	......
.762	.575	.856	.731	W	NE	NE	1.6	1.6	2.6	1.0	N. 26 E.	0	0	3	......	......
.820	.869	.856	.848	NE	NE	NE	0.9	1.2	5.4	2.7	N. 45 E.	8	0	10	......	......
.750	.861	.847	.819	SW	SE	NE	1.0	3.0	2.0	1.0	S. 63 E.	0	0	3	......	......
.836	.934	.856	.875	Calm	NE	Calm	0	1.6	0	0.6	N. 45 E.	10	0	0	......	......
.750	.483	.772	.668	Calm	SE	Calm	0	4.2	0	1.7	S. 45 E.	0	0	5	......	......
.937	.435	.872	.748	Calm	SW	NE	0	8.4	1.0	2.6	S. 45 W.	0	0	8	......	......
.790	.861	.925	.859	SW	SW	Calm	1.0	2.0	0	1.0	S. 45 W.	0	10	10	......	......
.925	.872	.918	.905	NE	NE	Calm	2.0	1.6	0	1.3	N. 45 E.	10	0	3	......	.19
.912	.747	.910	.856	NE	NE	NE	0.3	0.6	0.9	0.6	N. 45 E.	10	10	0	......	......
.896	.861	.856	.871	Calm	NE	NE	0	2.0	1.6	1.3	N. 45 E.	10	0	0	......	......
.923	.933	.861	.906	NE	NE	NE	0.6	1.6	6.4	2.7	N. 45 E.	6	0	0	......	......
.914	.872	.935	.907	Calm	NE	NE	0	1.0	0.9	0.7	N. 45 E.	0	0	3	......	......
.921	.935	.929	.928	NE	NE	NE	1.0	1.2	5.4	2.6	N. 45 E.	0	0	10	......	......
.927	.933	.923	.928	Calm	NE	Calm	0	2.4	0	0.7	N. 45 E.	10	3	10	......	......
.916	.472	.627	.672	Calm	SW	SW	0	6.0	2.0	2.7	S. 45 W.	3	0	0	......	......
.925	.874	.929	.909	Calm	NE	NE	0	2.0	1.0	1.0	N. 45 E.	10	3	5	......	......
.738	.932	.918	.863	SE	S	SW	2.0	3.6	1.2	2.0	S. 8 E.	3	10	0	......	......
.898	.825	.907	.877	NW	SW	Calm	2.0	4.2	0	1.7	S. 73 W.	0	0	0	......	.09
.923	.923	.923	.923	SE	NE	NE	2.4	1.6	3.0	1.7	N. 72 E.	0	10	10	......	......
.916	.916	.960	.911	NE	NE	NE	6.0	5.4	2.0	4.7	N. 45 E.	10	10	10	......	.35
.898	.903	.890	.897	NW	NW	NW	3.0	6.0	5.4	4.7	N. 45 W.	10	10	10	......	.63
.890	.896	.890	.892	NW	NW	NW	2.0	3.6	3.0	2.7	N. 45 W.	10	10	10	......	.19
.887	.896	.887	.890	NW	NE	NE	1.0	0.6	0.3	0.3	N. 8 W.	10	10	10	......	......
.893	.898	.893	.895	NE	NE	NE	2.0	3.6	1.0	2.3	N. 45 E.	10	10	10	......	.11
.893	.898	.898	.896	NE	NE	NE	1.0	2.0	1.2	1.3	N. 45 E.	10	10	10	......	......
.896	.807	......	.862	Calm	E	....	0	7.6	....	2.5	East	8	10	10	......	.19
.910	.907	.898	.905	NE	SW	SW	15.4	3.6	2.0	2.7	N. 45 E.	10	10	10	......	.50
.893	.898	.895	.899	Calm	SW	SW	0	2.0	1.0	1.0	S. 45 W.	10	10	10	......	.14
.893	.893	.864	.883	NW	NW	Calm	1.2	5.4	0	2.0	N. 45 W.	6	8	3	......	.06
.840	.896	.887	.874	Calm	NW	Calm	3	3.0	0	1.0	N. 45 W.	0	10	10	......	......
.895	.890	.903	.856	....	....	....	....	....	....	0.6	N. 23 E.	5.6	4.9	6.2	......	2.45

Reductions of the monthly meteorological register of the survey of

Date.	Barometer reduced to temperature of 32° Fahr., expressed in United States inches and decimals,				TEMPERATURE—FAHRENHEIT.									VAPOR.			
					Wet bulb, or point of evaporation.			Dry bulb, or temperature of the open air.				Maximum.	Minimum.	Elasticity, in U. S. inches and decimals.			
	7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	Mean.			7 a. m.	2 p. m.	9 p. m.	Mean.
1866.					°	°	°	°	°	°	°	°	°				
Nov. 1	28.988	29.182	29.314	29.161	33	36	31	34	37	32	34.3	37	28	.175	.199	.162	.179
2	29.498	29.544	29.580	29.541	30	36	21	31	38	22	30.3	39	20	.155	.186	.101	.147
3	29.726	29.705	29.763	29.731	24	30	19	25	32	20	25.7	35	11	.117	.144	.092	.118
4	29.945	29.962	29.986	29.964	31	35	31	32	36	32	33.3	37	18	.162	.191	.162	.172
5	30.001	29.845	29.770	29.872	15	35	31	16	37	32	28.3	41	12	.074	.178	.162	.138
6	29.592	29.474	29.384	29.483	37	40	41	38	42	42	40.7	43	29	.207	.221	.244	.224
7	29.286	29.141	29.102	29.176	40	44	40	41	45	41	42.3	46	29	.235	.275	.235	.248
8	29.187	29.164	29.194	29.182	38	54	45	40	58	48	48.7	58	39	.203	.365	.260	.276
9	29.372	29.393	29.413	29.393	33	50	35	36	58	37	43.7	58	35	.149	.255	.178	.194
10	29.345	29.254	29.272	29.290	36	35	34	37	36	35	36.0	38	28	.199	.191	.183	.191
11	29.288	29.297	29.327	29.304	29	33	26	30	34	27	30.3	36	25	.149	.175	.129	.151
12	29.343	29.447	29.434	29.408	26	33	31	27	35	32	31.3	35	22	.129	.162	.162	.151
13	29.262	29.209	29.092	29.188	35	37	39	37	39	40	38.7	41	35	.178	.194	.225	.199
14	28.932	28.900	28.979	28.937	37	40	36	38	41	37	38.7	41	35	.207	.215	.199	.214
15	28.942	28.788	28.770	28.833	32	32	33	33	33	34	33.3	39	30	.168	.168	.175	.170
16	29.033	29.102	29.120	29.085	33	33	30	34	35	31	33.3	37	30	.175	.162	.155	.164
17	29.018	28.935	29.025	28.993	29	38	31	30	39	32	33.7	41	22	.149	.216	.162	.176
18	29.135	29.100	29.105	29.113	29	42	33	30	47	34	37.0	47	27	.149	.202	.175	.175
19	29.020	29.080	29.297	29.132	29	38	29	30	40	31	33.7	41	28	.149	.203	.137	.163
20	29.446	29.435	29.398	29.426	21	27	21	22	28	22	24.0	32	18	.101	.136	.101	.113
21	29.268	29.160	29.175	29.201	26	28	27	27	30	28	28.3	31	20	.129	.130	.136	.132
22	29.300	29.410	29.480	29.430	28	27	22	30	28	24	27.3	30	20	.130	.136	.095	.120
23	29.553	29.550	29.623	29.575	21	27	11	22	29	12	21.0	30	10	.101	.124	.061	.095
24	29.619	29.510	29.453	29.527	14	25	11	15	26	12	17.7	29	8	.071	.123	.061	.085
25	29.084	29.010	29.040	29.045	18	33	24	20	36	25	27.0	37	8	.076	.149	.117	.114
26	29.061	29.190	29.240	29.164	16	33	35	18	36	36	30.0	37	15	.067	.149	.191	.136
27	28.988	28.828	28.831	28.882	35	36	33	36	37	34	35.7	39	33	.191	.199	.175	.188
28	28.998	29.128	29.188	29.105	21	23	21	22	24	22	22.7	35	20	.101	.112	.101	.105
29	29.319	29.248	29.321	29.296	17	24	17	18	25	18	20.3	28	15	.083	.117	.083	.094
30	29.430	29.358	29.383	29.390	2	26	9	3	28	10	13.7	31	0	.036	.117	.054	.069
Means....	29.299	29.281	29.302	29.294	....	....	....	28.4	36.2	29.4	31.4	...	...	.140	.180	.149	.156
Dec. 1	29.319	29.161	29.060	29.180	7	28	25	8	31	26	21.7	36	5	.048	.119	.123	.097
2	28.996	28.910	28.917	28.941	14	35	32	15	37	34	28.7	38	12	.071	.178	.155	.135
3	28.821	28.770	28.808	28.800	34	38	32	35	44	33	37.3	47	20	.183	.151	.168	.167
4	28.950	29.060	29.225	29.078	22	35	24	23	38	25	28.7	39	20	.107	.165	.117	.130
5	29.468	29.530	29.560	29.519	17	32	23	18	35	24	25.7	36	15	.083	.142	.112	.112
6	29.423	29.237	29.229	29.296	12	35	30	15	40	32	29.0	43	12	.041	.139	.155	.112
7	29.128	29.029	29.177	29.111	22	38	25	25	46	26	32.3	49	25	.081	.123	.123	.111
8	29.064	28.966	29.031	29.020	13	28	13	14	30	14	19.3	30	10	.067	.130	.067	.088
9	29.103	29.102	29.088	29.098	- 1	9	6	0	10	7	05.7	15	- 2	.030	.054	.046	.043
10	29.190	29.169	29.196	29.185	6	7	2	7	8	3	06.0	14	0	.046	.048	.036	.043
11	29.334	29.323	29.397	29.351	- 4	10	- 2	- 3	11	- 1	02.3	12	- 5	.025	.057	.028	.037
12	29.544	29.283	29.557	29.461	-11	13	- 3	-10	14	- 2	00.7	16	-12	.014	.067	.026	.036
13	29.622	29.640	29.709	29.657	- 9	10	10	- 8	12	11	05.0	14	-10	.017	.046	.057	.040
14	29.803	29.781	29.791	29.792	9	18	4	10	20	5	11.7	20	5	.054	.076	.041	.057
15	29.723	29.645	29.554	29.641	- 1	18	17	0	21	18	13.0	23	- 5	.030	.065	.083	.059
16	29.449	29.396	29.371	29.405	19	23	21	20	24	22	22.0	25	15	.092	.112	.101	.112
17	29.409	29.361	29.275	29.348	7	24	23	8	26	24	19.3	26	5	.048	.106	.112	.089
18	29.237	29.220	29.330	29.262	21	27	26	22	28	27	25.7	29	20	.101	.136	.129	.122
19	29.639	29.737	29.811	29.729	11	15	14	12	16	15	14.3	28	10	.061	.074	.071	.069
20	29.753	29.506	29.441	29.567	5	20	19	6	21	20	15.7	22	5	.043	.096	.092	.077
21	29.261	29.110	29.010	29.127	19	28	28	20	30	29	26.3	31	18	.092	.130	.142	.121
22	28.646	28.605	28.675	28.642	32	38	33	33	40	34	35.7	41	28	.168	.203	.175	.182
23	28.828	28.885	28.958	28.890	23	24	18	24	25	20	23.0	35	18	.112	.117	.076	.102
24	29.080	29.097	29.199	29.125	18	15	1	20	16	2	12.7	01	1	.076	.074	.023	.058
25	29.223	29.160	29.169	29.184	- 6	13	13	- 5	14	14	07.7	16	- 6	.021	.067	.067	.052
26	29.212	29.329	29.473	29.338	8	9	- 1	10	10	0	06.7	14	- 1	.040	.054	.030	.045
27	29.595	29.684	29.764	29.681	-14	7	- 4	-13	8	- 3	- 2.7	11	-18	.011	.048	.025	.028
28	29.780	29.744	29.851	29.792	-17	7	- 9	-16	8	- 8	- 5.3	10	-17	.008	.048	.017	.024
29	29.790	29.643	29.791	29.675	-13	1	-13	-12	2	-12	- 7.3	5	-14	.012	.034	.012	.019
30	29.420	29.142	29.238	29.267	-19	0	3	-18	1	4	- 4.3	5	-20	.006	.032	.038	.025
31	29.475	29.452	29.683	29.537	-13	5	- 9	-12	6	- 8	- 4.7	8	-14	.012	.043	.017	.024
Means....	29.331	29.280	29.327	29.313	....	....	....	08.0	21.7	14.0	14.6	....	....	.060	.098	.079	.079

the northern and northwestern lakes at Superior City, Wisconsin.

VAPOR.				WIND.								Amount of cloudiness. (0 = clear sky.) (10 = sky entirely overcast.)			Amount of evaporation, in U. S. inches and decimals.	Amount of rain or melted snow, in U. S. inches and decimals.
Humidity. Saturation = 1,000.				Direction. From whence.			Velocity, in miles, per hour.			Resultant velocity, in miles, per hour.	Resultant direction.					
7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.		°	7 a. m.	2 p. m.	9 p. m.		
.895	.903	.896	.898	N	N	Calm	3.6	4.2	0	2.6	North	6	4	10	......	......
.893	.811	.860	.855	NW	SW	NE	2.0	2.4	0.6	1.0	N. 79 W.	9	3	0	......	......
.872	.794	.850	.839	N	N	NE	2.4	1.6	5.4	2.7	N. 28 W.	0	0	3	......	......
.896	.900	.896	.897	NE	NE	E	1.0	3.6	0.6	1.7	N. 50 E.	5	0	4	......	......
.829	.807	.896	.844	Calm	NE	NE	0	2.0	2.0	1.3	N. 45 E.	0	0	0	......	......
.905	.829	.914	.883	SW	Calm	NE	0.6	0	1.0	0.7	N. 45 E.	9	6	10	......	......
.912	.920	.912	.915	Calm	NE	NE	0	2.0	0.6	0.7	N. 45 E.	8	10	10	......	.12
.820	.756	.777	.784	SW	SW	SW	2.0	4.2	0.3	2.3	N. 45 W.	4	0	0	......	.02
.705	.529	.807	.680	SW	SW	Calm	4.2	3.6	0	2.6	S. 45 W.	0	0	0	......	......
.903	.900	.898	.900	NE	NE	NE	3.6	8.4	3.6	5.0	N. 45 E.	10	10	10	......	......
.890	.895	.880	.888	NW	Calm	Calm	2.0	0	0	0.7	N. 45 W.	10	10	0	......	.38
.880	.797	.896	.858	NW	NW	SW	2.0	0.6	2.0	1.3	N. 80 W.	8	6	0	......	......
.807	.816	.910	.844	NE	NE	NE	1.0	0.6	7.2	3.0	N. 45 E.	7	10	10	......	......
.905	.912	.903	.907	NE	NE	SW	1.0	1.0	1.0	3.3	N. 45 E.	10	10	10	......	.24
.893	.893	.895	.894	SW	SW	Calm	1.0	2.0	0	1.0	S. 45 W.	10	10	10	......	.08
.895	.797	.893	.862	NW	NW	Calm	2.0	1.4	0	1.3	N. 45 W.	5	8	6	......	......
.890	.907	.896	.898	Calm	SW	Calm	0	1.6	0	0.6	S. 45 W.	10	7	0	......	......
.890	.624	.895	.803	SW	Calm	Calm	1.0	0	0	0.3	S. 45 W.	0	3	0	......	......
.890	.820	.788	.833	Calm	NW	NW	0	2.0	5.4	2.6	N. 45 W.	3	8	4	......	......
.860	.883	.860	.868	NW	SW	Calm	6.0	1.0	0	2.0	N. 54 W.	8	7	6	......	......
.880	.782	.883	.848	Calm	Calm	Calm	0	0	0	0.0	Calm	10	10	10	......	......
.782	.883	.738	.801	NW	NW	NW	2.0	1.2	0.6	1.3	N. 45 W.	8	6	3	......	.38
.860	.775	.804	.813	NW	NW	Calm	1.0	0.6	0	0.6	N. 45 W.	10	3	0	......	......
.823	.876	.804	.834	SW	SW	Calm	1.0	0.3	0	0.3	S. 45 W.	6	8	0	......	......
.702	.705	.872	.760	SW	SW	Calm	2.0	2.4	0	1.7	S. 45 W.	0	3	6	......	......
.682	.705	.900	.962	SW	NE	NE	1.0	2.0	8.4	3.3	N. 45 E.	0	4	10	......	......
.900	.903	.895	.899	NE	NE	NE	40.0	60.0	6.0	3.5	N. 45 E.	10	10	10	......	......
.860	.868	.860	.863	NW	NW	NW	2.0	1.6	4.2	2.7	N. 45 W	10	10	10	......	1.30
.849	.872	.849	.857	NW	NW	NW	2.0	1.0	2.0	1.7	N. 45 W	10	0	3	......	......
.730	.768	.791	.763	NW	NW	Calm	1.0	0.6	0	0.7	N. 45 W	0	3	0	......	......
.850	.824	.864	.846	....	....	....	....	....	....	1.7	N. 24 E	6.2	5.6	4.8	......	2.52
.777	.685	.876	.779	SW	Calm	Calm	1.0	0	0	0.3	S. 45 W.	0	0	0	......	......
.823	.807	.792	.807	Calm	Calm	Calm	0	0	0	0.0	Calm	0	4	10	......	......
.898	.522	.893	.771	Calm	NE	NW	0	1.2	1.6	0.7	N. 13 W.	10	3	0	......	.30
.864	.719	.872	.818	NW	NW	Calm	1.2	0.9	0	0.7	N. 45 W.	2	0	0	......	......
.840	.698	.868	.802	NW	NE	Calm	1.0	1.2	0	0.3	N. 16 E.	0	0	0	......	......
.475	.557	.792	.608	SW	SW	SW	1.0	5.4	1.2	2.7	S. 45 W.	0	3	0	......	......
.622	.400	.876	.633	SW	SW	SW	0.6	4.2	7.2	4.0	S. 45 W.	0	3	10	......	......
.816	.782	.816	.805	Calm	SW	SW	0	2.0	0.6	0.7	S. 45 W.	3	0	10	......	......
.695	.791	.769	.752	NW	SW	SW	2.0	3.0	2.0	1.7	S. 65 W.	10	10	10	......	......
.769	.777	.730	.759	SW	SW	SW	5.4	3.6	2.0	3.7	S. 45 W.	10	10	3	......	......
.658	.797	.683	.713	NW	NW	NW	2.4	5.0	3.6	3.0	N. 45 W.	3	0	4	......	......
.589	.816	.671	.675	SW	SW	Calm	1.0	1.2	0	0.7	S. 45 W	0	0	0	......	......
.577	.610	.797	.661	SW	NE	Calm	0.6	1.0	0	0.2	N. 45 E.	3	4	10	......	......
.791	.702	.750	.748	SW	NE	Calm	1.0	2.0	0	0.3	N. 45 E.	10	8	0	......	.05
.695	.570	.840	.702	SW	Calm	NE	1.0	0	1.6	0.3	N. 45 E.	0	0	4	......	......
.850	.868	.860	.859	NE	NE	NE	2.0	1.0	1.0	1.3	N. 45 E.	10	10	10	......	......
.777	.754	.868	.800	SW	NE	Calm	1.0	0.9	0	0.1	S. 45 W.	0	0	10	......	......
.860	.883	.880	.874	SE	SW	NE	1.0	0.6	2.0	0.7	N. 77 E.	10	10	10	......	......
.804	.829	.823	.819	NE	NE	NE	8.4	6.0	4.2	6.0	N. 45 E.	10	10	10	......	......
.760	.855	.850	.822	NE	NW	NE	2.0	1.6	2.0	1.3	N. 25 E.	6	10	10	......	.10
.850	.782	.887	.840	SW	SW	Calm	0.6	1.0	0	0.3	S. 45 W	10	10	10	......	......
.893	.820	.895	.869	Calm	SW	SW	0	4.2	3.6	2.7	S. 45 W.	10	10	0	......	......
.868	.872	.702	.814	SW	SW	SW	3.0	4.2	2.0	3.0	S. 45 W.	10	10	8	......	......
.702	.829	.460	.664	NW	NW	NW	4.2	3.6	2.0	3.2	N. 45 W.	10	10	0	......	......
.627	.816	.816	.753	NE	NW	SW	1.0	0.6	2.0	0.3	S. 73 W.	0	10	10	......	......
.582	.791	.695	.689	Calm	NW	NW	0	4.2	1.0	1.7	N. 45 W.	10	3	10	......	......
.474	.777	.658	.636	NW	NW	NW	1.0	5.4	2.0	2.7	N. 45 W.	0	0	0	......	......
.395	.777	.577	.583	NW	NW	SW	1.0	0.6	1.0	0.7	N. 67 W.	0	0	0	......	......
.498	.718	.498	.571	SW	SW	SW	2.0	2.4	1.0	1.7	S. 45 W.	10	0	0	......	......
.335	.707	.740	.594	Calm	Calm	NE	0	0	1.0	0.3	N. 45 E.	10	10	10	......	......
.498	.760	.577	.612	SW	NW	NW	1.0	2.0	2.4	1.3	N. 53 W.	3	0	0	......	.15
.697	.744	.768	.736	....	....	....	....	....	....	6.2	N. 83 W.	5.1	4.8	5.1	......	.60

Reductions of the monthly meteorological register of the survey of

Date.	Barometer reduced to temperature of 32° Fahr., expressed in United States inches and decimals.				TEMPERATURE—FAHRENHEIT.									VAPOR.			
					Wet bulb, or point of evaporation.			Dry bulb, or temperature of the open air.				Maximum.	Minimum.	Elasticity, in U. S. inches and decimals.			
	7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	Mean.			7 a. m.	2 p. m.	9 p. m.	Mean.
1866.					°	°	°	°	°	°	°	°	°				
July 1	29.313	29.262	29.300	29.292	61	64.5	60	67.5	80	68	71.8	81.8	63.2	.450	.389	.411	.417
2	29.290	29.212	29.102	29.201	61	65	60.5	65	71	67.5	67.8	79.5	60.5	.483	.537	.439	.485
3	28.947	28.884	28.966	28.932	60	66	57	64.5	69.5	62.5	65.5	76.5	60.5	.456	.592	.392	.481
4	28.966	28.915	28.959	28.947	56	67.5	66	58	75	69.5	67.5	29	50.4	.422	.571	.592	.528
5	28.943	28.986	29.018	28.982	65	63.5	57	64.5	68.5	59	64.0	74	57	....	.519	.439	.479
6	29.059	29.027	29.023	29.036	57.5	57	62	59	60	62.5	60.5	68	56	.454	.426	.549	.476
7	29.159	29.173	29.267	29.200	61.5	61	53.5	64	66	58	62.7	71.5	56.5	.512	.470	.345	.442
8	29.456	29,548	29.579	29.528	50	55	53	52.5	61.5	55	56.3	65.5	49	.328	.347	.376	.350
9	29.643	29.535	29.480	29.553	44	58.5	61	45.5	65	55.5	55.3	73	39.5	.268	.405	....	.227
10	29.475	29.379	29.362	29.405	59	68	88	64	86.5	75	75.2	58	64.4	.433	.436	....	.435
11	29.391	29.280	29.291	29.321	67	72	71	72.5	93	81.5	82.3	93	64.5	.588	.501	.617	.569
12	29.271	29.280	29.270	29.274	74	72.5	75	80	82	82	81.3	94.5	75.5	.758	.667	.773	.733
13	29.296	29.258	29.285	29.280	63	70	65	65.5	78	67	70.2	81.5	62	.542	.625	.591	.586
14	29.188	29.222	29.136	29.182	65	70	73	66	76	80.5	74.2	87.5	63	.604	.652	.710	.655
15	29.127	29.119	29.217	29.154	73	75	70	78	84	72	78.0	88	68	.744	.746	.706	.732
16	29.233	29.257	29.335	29.275	64	74	66	65	83.5	70	72.8	85	64	.583	.711	.586	.627
17	29.457	29.463	29.558	29.293	61	65	56	54.5	59	59	57.5	62.5	60	....	....	.409	.409
18	29.441	29.403	29.396	29.413	54	63	61	55.5	72	63.5	63.7	77	47.5	.398	.455	.503	.452
19	29.414	29.367	29.327	29.369	50	65.5	55	60.5	78	70	69.5	84.2	53	.222	.595	.234	.350
20	29.346	29.291	29.249	29.295	61	73	65.5	64	79	70	71.0	80.5	58	.497	.730	.558	.595
21	29.196	29.185	29.178	29.186	61.5	67	78	64	69	66	66.3	73.5	57.2	.512	.635	....	.574
22	29.198	24.313	29.339	29.283	61.5	60	57	63	64.5	58.5	62.0	66.2	57	.526	.458	.446	.477
23	29.348	29.269	29.309	29.309	53.5	61	56	52	63	60	58.3	67	53	....	.510	.396	.453
24	29.307	29.320	29.344	29.324	55	69	63.5	56	77	67	66.7	86.5	56	.420	.601	.539	.520
25	29.414	29.384	29.417	29.405	61	68.5	62	64	92	70	75.3	84	57	.497	.516	.449	.487
26	29.336	29.300	29.335	29.324	65.5	68	64	69	76	68	71.0	78	62	.581	.577	.543	.567
27	29.370	29.371	29.342	29.361	62	66	62	62	72	66	66.7	76	61	.556	.559	.502	.539
28	29.371	29.309	29.276	29.319	62	68	64	64	79	68	70.3	82	58	.529	.537	.543	.536
29	29.307	29.278	29.106	29.230	63	62	58	60	68	63	63.7	76	60	....	.476	.416	.446
30	29.378	29.304	29.205	29.296	58	63	64	60	70	70	66.7	82	57	.456	.482	.516	.485
31	29.067	28.987	28.990	29.021	64	75	60	65	83	62	70.0	83	62	.583	.760	.491	.611
Means....	29.281	29.254	29.257	29.264	....	....	....	62.7	74.2	66.7	67.9	....	....	.496	.550	.502	.507
August 1	29.063	29.099	29.283	29.148	55	56	54	60	60	56	58.7	65	55	.367	.396	.391	.385
2	29.390	29.297	29.227	29.305	55	62	58	56	70	65	63.7	79	54	.420	.449	.389	.419
3	29.348	29.328	29.434	29.370	58	54	53	60	56	55	57.0	65	54	.456	.391	.376	.408
4	29.614	29.571	29.583	29.589	49	58	56	50	64	59	57.7	72	42	.335	.403	.409	.382
5	29.616	29.576	29.546	29.579	50	61	56	51	66	57	58.0	72	45	.348	.449	.369	.389
6	29.554	29.451	29.446	29.484	51	62	56	52	70	62	61.3	74	46	.361	.449	.369	.393
7	29.437	29.363	29.332	29.377	55	64	58	58	73	66	65.7	83	56	.393	.476	.376	.415
8	29.304	29.288	29.267	29.286	57	56	56	59	58	52	56.3	68	56	.439	.429	.422	.428
9	29.287	29.344	29.364	29.332	54.5	62	57	56	68	61	61.7	73	52	.405	.476	.412	.431
10	29.368	29.340	29.333	29.347	57	66	64	59	76	68.5	67.8	81.6	55.5	.439	.505	.536	.493
11	29.345	29.280	29.263	29.296	60	65	65	63	70	68	67.0	81	56	.478	.550	.577	.535
12	29.216	29.234	29.310	29.253	62	62	58	63.5	65.5	59.5	62.8	58	56.5	.536	.509	.463	.513
13	29.361	29.325	29.205	29.297	58	64	71	60.5	69.5	73	67.8	77.5	60	.463	.583	.731	.592
14	29.340	29.426	29.545	29.437	60	66	56	62.5	74	62	66.2	65	47.5	.485	.604	.369	.486
15	29.722	29.706	29.672	29.700	49	56	53	51	63	54	56.0	62	46	.381	.386	.389	.385
16	29.630	29.510	29.463	29.534	54	67	66	55.5	75.5	70	67.0	78.5	44	....	.549	.586	.568
17	29.443	29.466	29.470	29.460	65	64	62	68.5	69	63.5	67.0	69	47.5	.570	.529	.536	.545
18	29.431	29.400	29.394	29.408	51	62	53	52.5	68	57	59.2	73	46.5	.354	.476	.250	.360
19	29.413	29.375	29.262	29.350	51	60	55	52.5	69	58	59.8	68	50	.354	.396	.393	.381
20	29.218	29.250	29.272	29.247	56	58.5	55	59	65	59	61.0	59	46	.409	.404	.380	.398
21	29.285	29.338	29.321	29.315	50	49	46	57.5	50.5	41	49.7	61	44	.262	.330	....	.296
22	29.337	29.353	29.394	29.361	47	35	49	48.5	59	50	52.8	55	47.5	.280	.380	.335	.332
23	29.403	29.383	29.350	29.379	47	46	47.5	51	51	52	51.3	61.5	46	.270	.248	.264	.261
24	29.381	29.391	29.370	29.381	46	53.5	51	49	38	56	47.7	72.7	44	.271	.348	.308	.309
25	29.356	29.243	29.229	29.276	46	61	56	48.5	68	59	58.5	70.8	51	.278	.443	.409	.377
26	29.063	29.081	29.147	29.097	57	62	55	59.5	66	58.5	61.3	64.6	43.6	.432	.501	.387	.440
27	29.230	29.282	29.291	29.268	45.5	35.5	50	47	61	52	53.3	64.9	43.6	.285	.365	.334	.328
28	29.375	29.284	29.302	29.320	40	61	51	48	64.5	54.5	55.7	67.5	41.5	.143	.490	.328	.320
29	29.324	29.287	29.284	29.298	47	38.5	50	47	63	53	54.3	66.5	42.4	.323	.431	.321	.358
30	29.285	29.212	29.217	29.238	40.5	39	49.5	42	66	52	53.3	67.8	38.5	.233	.407	.321	.320
31	29.127	29.025	28.969	29.040	50	63	64.5	52.5	66.5	67	62.0	72.2	46.2	.288	.570	.573	.477
Means....	29.363	29.339	29.340	29.347	....	....	....	54.8	64.6	58.9	59.5	....	....	.368	.445	.413	.410

the northern and northwestern lakes at Ontonagon, Michigan.

VAPOR.				WIND.								Amount of cloudiness. (0=clear sky.) (10=sky entirely overcast.)			Amount of evaporation, in U. S. inches and decimals.	Amount of rain or melted snow, in U. S. inches and decimals.
Humidity. Saturation=1,000.				Direction. From whence.			Velocity, in miles, per hour.			Resultant velocity, in miles, per hour.	Resultant direction.					
7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.		°	7 a. m.	2 p. m.	9 p. m.		
.669	.390	.601	.553	S	S	S	12	12	4	9.3	South	4	4	4	......	......
.783	.708	.644	.712	S	S	S	12	4	12	9.3	South	7	7	2	......	......
.755	.822	.694	.757	S	W	W	25	12	25	15.3	S. 56 W.	3	4	1	......	......
.876	.659	.822	.786	S	S	W	4	12	4	5.7	S. 14 W.	4	0	0	......	.60
......	.745	.876	.812	S	NE	N	4	12	4	4.0	N. 45 E.	5	4	0	......	.60
.908	.822	.971	.900	S	W	Calm	4	4	0	2.0	S. 45 W.	7	7	7	......	......
.860	.735	.727	.774	S	W	W	12	25	25	17.3	S. 14 W.	0	0	0	......	.55
.829	.635	.869	.778	N	W. NW	S	12	12	4	7.7	N. 89 W.	4	2	0	......	......
.881	.655	......	.768	S	NE	S	2	12	4	3.0	N. 74 E.	0	0	0	......	......
.727	.346	......	.537	S	S	S	12	4	4	6.7	South	3	2	2	......	......
.737	.324	.574	.545	S	N	S	12	4	12	6.7	South	0	0	0	......	......
.741	.613	.708	.687	S.SW	NW	Calm	12	12	0	4.7	S. 81 W.	0	0	2	......	......
.864	.653	.893	.803	S	NE	NW	12	25	12	5.7	N 33 E.	4	3	0	......	.06
.945	.727	.683	.785	NW	NE	S	12	25	12	5.7	N. 33 E.	8	3	0	......	.47
.776	.640	.900	.772	SW	NE	S	12	12	25	8.3	South	3	3	8	......	......
.944	.620	.799	.788	Calm	NW	W	0	12	12	7.3	N. 67 W.	2	2	2	......	.80
......	......	.819	.819	S	N	S	4	4	2	0.7	South	6	4	2	......	......
.902	.582	.859	.781	S	N	W	4	4	4	1.3	West	0	2	0	......	......
.422	.869	.320	.537	W	N	S	4	4	4	1.3	West	0	0	0	......	......
.833	.738	.774	.782	S	N	W	12	12	4	1.3	West	0	4	0	......	......
.860	.896	......	.878	Calm	NE	NE	0	25	12	12.3	N. 45 E.	5	6	4	......	......
.914	.755	.907	.859	NE	NE	NE	12	4	4	6.7	N. 45 E.	6	6	8	......	......
......	.886	.765	.826	Calm	W. NW	S	0	4	4	1.3	S. 52 W.	9	5	5	......	......
.935	.648	.815	.799	S	N	S	4	12	12	1.3	South	0	2	0	......	......
.833	.472	.613	.639	S	NE	S	4	12	2	3.3	N. 74 E.	0	2	4	......	......
.820	.644	.793	.752	N	NE	S	2	2	2	0.7	N. 45 E.	5	3	0	......	......
1.000	.712	.786	.833	Calm	NE	S	0	4	2	1.0	N. 75 E.	10	10	0	......	......
.888	.542	.793	.741	NE	NE	S	2	12	2	4.0	N. 51 E.	10	0	0	......	......
......	.695	.723	.709	S	N	W	12	12	4	1.3	West	0	0	0	......	......
.880	.658	.704	.747	S	NE	S	2	25	12	6.0	N. 79 E.	0	3	5	......	......
.944	.673	.884	.834	S	NW	NW	25	25	35	6.3	N. 22 W.	10	10	0	......	......
.829	.662	.761	.751	......	......	......	....	....	....	1.0	S. 43 W.	3.7	3.2	1.9	......	3.10
.708	.765	.872	.782	NW	N	N	35	4	12	15.7	N. 31 W.	0	0	4	......	.45
.935	.613	.631	.726	NE	S	NE	25	2	12	12.0	N. 47 E.	10	3	10	......	.10
.880	.872	.869	.874	S	S	N	2	2	2	0.7	South	0	0	0	......	......
.927	.675	.819	.807	S	S	S	2	2	4	2.7	South	0	10	10	......	......
.929	.613	.665	.736	S	SW	NE	2	2	12	3.0	N. 53 E.	0	3	2	......	......
.930	.613	.665	.736	S	S	NE	2	2	12	3.3	N. 63 E.	10	5	9	......	......
.816	.588	.588	.664	SW	NE	NE	4	2	4	0.7	N. 45 E.	10	10	10	......	......
.878	.876	.876	.877	NE	NE	S	2	4	12	3.0	S. 30 E.	10	10	0	......	.10
.903	.695	.769	.789	S	NW	E	2	12	12	2.3	N. 25 E.	2	2	3	......	.40
.878	.563	.770	.737	S	NE	S	4	12	4	2.7	N. 87 E.	2	3	2	......	......
.831	.751	.843	.808	S	NE	S	12	25	25	8.7	S. 43 E.	5	3	8	......	......
.915	.811	.909	.878	Calm	SE	NE	0	25	25	11.8	East	0	8	0	......	.42
.909	.725	.902	.845	N	NE	S	4	12	4	4.0	N. 45 E.	0	0	6	......	......
.857	.720	.665	.747	N	NW	NE	35	12	25	20.7	N. 9 E.	0	2	6	......	......
.859	.617	.933	.787	S	NE	S	4	25	12	6.0	N. 85 E.	3	0	0	......	......
......	.621	.799	.710	S	NE	S	4	2	25	9.0	S. 3 E.	2	3	3	......	......
.819	.747	.915	.827	S.SW	W	S	12	12	4	7.3	S. 47 W.	2	3	2	......	......
.897	.695	.752	.781	S	NE	S	4	25	4	6.7	N. 61 E.	0	3	3	......	......
.897	.564	.816	.759	S	W	S	2	25	25	12.3	S. 43 W.	0	3	2	......	......
.819	.655	.761	.745	NW	NW	NW	35	25	35	31.7	N. 45 W.	6	4	3	......	......
.553	.893	......	.723	NE	NE	S	60	35	4	30.7	N. 47 E.	8	6	4	......	.42
.819	.761	.927	.836	NE	NE	S	12	12	4	7.3	N. 53 E.	8	3	8	......	......
.722	.653	.689	.688	N	NW	NE	35	35	45	30.7	N. 4 E.	8	8	8	......	......
.781	.727	.687	.732	N	N	N	35	25	12	24.0	North	8	7	2	......	......
.815	.647	.819	.760	N	W	S	25	25	12	9.7	N. 63 W.	0	3	3	......	......
.850	.786	.788	.808	S	NE	NE	4	4	4	2.0	N. 75 E.	3	3	2	......	......
.884	.686	.861	.810	E	NE	S	4	25	4	8.3	N. 58 E.	2	2	2	......	.15
.426	.808	.772	.669	S	W	S	2	4	2	2.0	S. 45 W.	8	3	2	......	......
1.000	.749	.798	.849	S	NE	S	4	12	4	2.7	N. 86 E.	3	2	2	......	......
.871	.636	.827	.778	Calm	NE	S	0	25	4	7.3	N. 52 E.	0	3	2	......	......
.829	.814	.867	.837	S	S	S	12	25	25	20.7	South	4	7	6	......	......
.834	.708	.794	.777	......	......	......	....	....	....	4.0	N. 23 E.	3.7	4.0	4.0	......	2.04

Reductions of the monthly meteorological register of the survey of

Date.	Barometer reduced to temperature of 32° Fahr., expressed in U. S. inches and decimals. 7 a. m.	2 p. m.	9 p. m.	Mean.	TEMPERATURE—FAHRENHEIT. Wet bulb, or point of evaporation. 7 a. m.	2 p. m.	9 p. m.	Dry bulb, or temperature of the open air. 7 a. m.	2 p. m.	9 p. m.	Mean.	Maximum.	Minimum.	VAPOR. Elasticity, in U. S. inches and decimals. 7 a. m.	2 p. m.	9 p. m.	Mean.
1866.					°	°	°	°	°	°	°	°	°				
Sept. 1	28.905	28.980	29.032	28.972	68	59	50.5	68	64	66	66.0	70.5	50	.612	.433	.162	.402
2	29.092	29.114	29.219	29.142	55	60.5	53.5	56.5	62	57	58.5	72	46	.413	.507	.363	.428
3	29.253	29.247	29.296	29.265	52	62	55	55	69	61	61.7	73	50	.349	.462	.354	.388
4	29.188	29.209	29.238	29.212	53	55	49	54	56.5	45	51.8	61	42.5	.389	.413	....	.401
5	29.253	29.267	29.329	29.283	42	61	52	42.5	62.5	52	55.7	66.5	43.5	.260	.517	.388	.388
6	29.375	29.322	29.323	29.340	45	60	55	46	62	56	53.3	65	42.5	.286	.491	.420	.399
7	29.273	29.210	29.223	29.235	48	56	55	49	58	56	54.3	61	47	.322	.422	.420	.388
8	29.320	29.433	29.562	29.438	52.5	57	48	54	61	49	54.7	64	45	.375	.412	.322	.373
9	29.650	29.604	29.544	29.599	44	62	58	45	64	58	55.7	69	40.5	.275	.529	.482	.429
10	29.479	29.354	29.286	29.373	45	62	50.5	45.5	67	52	54.8	70	43.5	.293	.489	.347	.376
11	29.126	28.995	28.899	29.007	47	59.5	57.5	48.5	65.5	60	58.0	68.5	42.5	.303	.429	.440	.391
12	28.781	28.802	29.048	28.877	50	50	49	52	55	54	53.7	68	42.5	.334	.295	.282	.304
13	29.213	29.254	29.237	29.235	44	48	41	51	57.5	42.5	50.3	59	41	.196	.216	.238	.217
14	29.348	29.419	29.455	29.407	33	46	43	43	49	44	45.3	51.5	39.5	.058	.271	.264	.198
15	29.495	29.363	29.240	29.366	39.5	60	50	41	66	51	52.7	67	40.5	.223	.438	.348	.336
16	29.142	29.316	29.418	29.292	52	49	50	53.5	57	45	51.8	55.5	47	.368	.242	....	.305
17	29.215	29.424	29.386	29.442	35.5	51.5	43.5	36.5	53	45	44.8	54	33	.195	.361	.263	.273
18	29.385	29.348	29.378	29.370	38	48.5	39.5	39	53	40	44.0	55.5	37.5	.216	.282	.236	.245
19	29.278	29.250	29.274	29.267	44	64	60	45	85.5	61	63.8	86	59	.275	.309	.505	.363
20	29.465	29.609	29.637	29.570	54	57	36.5	58.5	62	37.5	52.7	71.5	38.5	.358	.399	.203	.320
21	29.628	29.448	29.516	29.531	42.5	53.5	50	50	64	55.5	56.5	54.5	33.5	.169	.271	.288	.243
22	29.268	29.099	29.235	29.201	35	71.5	53.5	61.5	88.5	59.5	69.8	88.5	48	....	.542	.330	.291
23	29.495	29.476	29.526	29.499	48.5	48	42	57	55.5	44.5	52.3	60	43	.229	.243	.234	.235
24	29.468	29.361	29.524	29.451	41.5	50	38.5	44.5	53.5	40	46.0	56	39	.223	.315	.214	.284
25	29.652	29.599	29.612	29.621	41	49	42	44.5	51.5	45	47.0	79	29	.211	.315	.228	.251
26	29.614	29.536	29.482	29.544	43	55.5	53.5	46	63.5	59.5	56.3	66	38	.238	.341	.330	.303
27	29.399	29.275	29.331	29.335	54.5	66	58.5	58.5	71.5	63.5	64.5	79.5	38.5	.372	.566	.424	.454
28	29.518	29.242	29.235	29.342	60.5	65.5	62	68.5	87	71.5	75.7	87	38.5	.420	.340	.429	.396
29	29.247	29.217	29.159	29.208	53.5	59	47.5	55	64	49.5	56.2	65	48.5	.390	.433	.303	.375
30	29.239	29.324	29.456	29.340	40.5	48	45	42	50	46.5	46.2	56.5	38	.233	.309	.280	.274
Means....	29.336	29.303	29.337	29.325	....	....	....	50.4	62.6	52.2	55.1	....	....	.296	.386	.325	.334
Oct. 1	29.268	29.098	29.235	29.200	55	61.5	53.5	61.5	88.5	59.5	69.8	88.5	48	.347	.440	.325	.373
2	29.435	29.476	29.526	29.479	48.5	48	42	51	55.5	48.5	51.7	66	43	.308	.236	.182	.242
3	29.468	29.481	29.524	29.491	41.5	49	38.5	44.5	51	40	45.2	56	39	.228	.321	.214	.254
4	29.651	29.599	29.602	29.617	41	50	42	44.5	59.5	45	49.7	79	29	.211	.235	.228	.225
5	29.630	29.536	29.482	29 549	43	55.5	53.5	46	63.5	59	56.2	66.5	38	.238	.335	.337	.303
6	29.404	29.275	29.351	29.343	54.5	66	58	58.5	71.5	63.5	64.5	79.5	38.5	.372	.566	.416	.451
7	29.348	29.242	29.235	29.275	60.5	75.5	65	68.5	87	71.5	75.7	87	38.5	.421	.728	.530	.560
8	29.149	29.118	29.159	29.142	53.5	59	47.5	55	64	49.5	56.2	65	48.5	.390	.433	.303	.375
9	29.295	29.324	29.435	29.341	40.5	48	42	42	52	46.5	46.8	56.5	38	.233	.282	.280	.265
10	29.499	29.532	29.600	29.544	45	49	41	46	53	42	47.0	55	41	.286	.295	.244	.275
11	29.586	29.455	29.417	29.486	33	50	44	34.5	53	46	44.5	55	29.5	.169	.321	.262	.251
12	29.495	29.218	29.319	29.344	42	61	53	46.5	68	55	56.2	69	37	.208	.443	.376	.342
13	29.397	29.380	29.464	29.414	49	68	51	51.5	76	53	60.2	76.5	45	.315	.577	.248	.413
14	29.742	29.640	29.719	29.700	47	55	48	49.5	60	50.5	53.3	76	42	.290	.367	.302	.320
15	29.737	29.891	29.822	29.817	43	57	44	43.5	60	46	53.2	65	38.5	.271	.426	.262	.320
16	29.809	29.686	29.619	29.705	41	57	50	42	63.5	53	52.8	65.5	40	.244	.379	.321	.315
17	29.488	29.314	29.247	29.350	42.5	61	51	46	67	55.5	56.2	71	42	.226	.457	.315	.333
18	29.390	29.854	29.056	29.433	49	57.5	48	53	58.5	55	55.5	72	40	.295	.460	.243	.333
19	29.205	29.225	29.302	29.244	42.5	52	41	43.5	56	44.5	48.0	56	38	.259	.335	.211	.268
20	29.372	29.163	29.034	29.190	45	59	43	48.5	63.5	48.5	53.5	69.5	38	.253	.440	.205	.299
21	28.901	28.781	28.591	28.758	48	48	48	50	49	49.5	49.5	67.5	42	.309	.320	.315	.315
22	28.565	28.674	28.858	28.699	38	35.5	38	40	37	39.5	38.8	50	38.5	.203	.188	.210	.200
23	28.961	29.300	29.479	29.247	32	32	32	32	33	32.5	32.5	34.5	30	.181	.168	.175	.175
24	29.522	29.512	29.451	29.495	31.5	33	30.5	32	35.5	31	32.8	36.5	29.5	.168	.156	.164	.163
25	29.392	29.329	29.307	29.343	30	33	33	30	34.5	34.5	33.0	36	28	.167	.168	.169	.168
26	29.221	29.273	29.389	29.294	33	38	32	34	40	34	36.0	41	32	.175	.203	.155	.144
27	29.535	29.480	29.406	29.474	29	37	34	29	39	35	31.0	40	37	.160	.194	.183	.179
28	29.054	28.952	29.037	29.014	34	38	39	35.5	38.5	40	38.0	41	32.5	.176	.223	.225	.208
29	29.199	29.115	29.147	29.154	34	36.5	33	35.5	38	34	35.8	41	32	.176	.175	.175	.175
30	29.316	29.407	29.527	29.417	31.5	31.5	29	32	35	29.5	32.2	36	28	.171	.134	.154	.153
31	29.539	29.361	29.279	29.393	25	31	29.5	26	31	30	29.0	31.5	23	.123	.174	.157	.151
Means....	29.372	29.345	29.342	29.353	....	....	....	43.6	54.2	45.9	47.9	....	....	.244	.328	.256	.276

the northern and northwestern lakes at Ontonagon, Michigan.

VAPOR.				WIND.									Amount of cloudiness. (0 = clear sky.) (10 = sky entirely overcast.)			Amount of evaporation, in U. S. inches and decimals.	Amount of rain or melted snow, in U. S. inches and decimals.
Humidity. Saturation = 1,000.				Direction. From whence.			Velocity, in miles, per hour.			Resultant velocity, in miles, per hour.	Resultant direction.						
7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.				7 a. m.	2 p. m.	9 p. m.		
.895	.727	.255	.626	S......	W......	S......	12	35	4	13.0	S. 65 W.		7	4	0	......	......
.904	.912	.782	.866	SW ...	NW ...	S......	25	35	25	15.0	S. 67 W.		8	3	0	......	......
.805	.653	.659	.706	S......	W......	S......	12	25	25	15.0	S. 34 W.		2	3	8	......	......
.933	.904	......	.919	NE....	NE....	NE....	25	35	25	28.3	N. 45 E.		10	10	7	......	......
.957	.913	1.000	.957	SE....	W......	S......	12	12	4	4.3	S. 16 W.		7	3	6	......	.63
.921	.884	.935	.913	S......	NE....	S......	25	4	4	9.0	S. 5 E..		6	7	10	......	......
.926	.876	.935	.912	S......	W......	S......	12	12	4	6.7	S. 37 W.		3	7	8	......	.53
.900	.769	.926	.865	NE....	NE....	S......	12	4	4	4.7	N. 57 E.		3	3	0	......	.26
.920	.788	1.000	.903	W......	NE....	E	2	4	2	1.3	N. 45 E.		0	3	0	......	......
.960	.740	.896	.865	S......	NE....	S......	4	12	4	2.7	N. 84 E.		0	3	0	......	......
.888	.682	.851	.807	SE....	NE....	S......	4	4	12	4.3	S. 23 E.		5	7	7	......	......
.861	.681	.674	.739	NW...	NW ...	NW ...	60	60	45	35.0	N. 45 W.		8	8	3	......	......
.525	.448	.873	.615	W......	NW ...	S......	35	25	12	17.7	N. 84 W.		2	1	0	......	......
.210	.781	.918	.636	NE....	NW ...	S......	60	60	12	24.3	South ..		3	6	6	......	.08
.867	.685	.929	.827	S......	S......	S......	25	12	12	16.3	South ..		0	5	10	......	......
.899	.521	......	.710	NW...	NW...	NW ...	35	60	35	43.3	N. 45 W.		7	5	6	......	......
.901	.898	.879	.893	S......	W......	W......	25	35	12	18.0	S. 62 W.		3	8	1	......	......
.907	.699	.954	.853	N	W......	W......	2	12	4	5.7	N. 83 W.		2	8	0	......	......
.920	.253	.941	.705	SW ...	SW ...	SW ...	25	25	35	28.3	S. 45 W.		0	0	0	......	......
.729	.718	.904	.784	SE....	....	Calm ..	2	....	0	0.7	S. 45 E.		0	0	0	......	......
.477	.455	.654	.529	SE....	Calm ..	Calm ..	25	0	0	8.3	S. 45 E.		0	0	0	......	......
......	.403	.650	.527	SE....	SE....	W......	45	60	25	29.7	S. 33 E.		0	0	0	......	......
.452	.561	.798	.604	NW ...	NW ...	S......	25	4	2	9.0	N. 48 W.		7	0	0	......	......
.759	.767	.864	.797	S......	S......	S......	2	2	2	2.0	South ..		0	0	0	......	......
.720	.826	.762	.769	SE....	SE....	SE....	12	25	4	13.7	S. 45 E.		9	0	0	......	......
.767	.571	.650	.663	SE....	SE....	SE....	60	60	25	48.3	S. 45 E.		8	2	0	......	......
.758	.733	.725	.739	SE....	SW ...	SE....	25	12	12	13.0	S. 27 E.		8	9	4	......	......
.604	.265	.556	.475	SE....	SW ...	SE....	12	45	4	16.0	S. 25 W.		0	0	0	......	......
.901	.727	.854	.827	W......	S......	N	12	2	2	4.0	West...		3	2	2	......	......
.871	.856	.883	.870	W......	NE....	Calm ..	2	4	0	1.0	N. 16 E.		0	10	10	......	.43
.798	.693	.811	.763	....	....	....	.....	.....	...	3.6	S. 51 W.		3.7	3.9	2.9	......	1.93
.635	.629	.650	.638	SE....	SE....	W......	45	60	60	25.3	S. 11 W.		7	0	0	......	......
.824	.536	.534	.631	SW ...	NW ...	....	25	4	....	8.3	S. 55 W.		7	0	0	......	......
.759	.859	.864	.827	Calm ..	Calm ..	Calm ..	0	0	0	0.0	Calm ...		9	6	0	......	......
.720	.463	.762	.648	SE....	SE....	SE....	12	25	4	13.7	S. 45 E.		8	2	0	......	......
.767	.571	.675	.671	SE....	SE....	SE....	60	60	25	48.3	S. 45 E..		8	9	4	......	......
.758	.733	.723	.738	SE....	SW ...	SE....	25	12	12	13.0	S. 27 E..		0	0	0	......	......
.604	.567	.688	.620	SE....	SW ...	SE....	12	45	4	16.0	S. 25 W.		3	2	2	......	......
.901	.727	.854	.827	W	Calm ..	N	4	0	4	2.0	N. 45 W.		10	0	3	......	......
.871	.727	.883	.827	Calm ..	NE....	Calm ..	0	4	0	1.3	N. 45 E.		0	9	9	......	.43
.921	.733	.914	.856	Calm ..	W......	Calm ..	0	12	0	4.0	West ...		9	8	0	......	......
.845	.798	.843	.829	Calm ..	NE....	Calm ..	0	12	0	4.0	N. 45 E.		0	8	0	......	......
.657	.647	.869	.724	E	SE....	SE....	4	35	4	14.0	S. 49 E..		0	1	0	......	......
.826	.644	.864	.778	SE....	SE....	Calm ..	45	12	0	19.0	S. 45 E..		0	1	0	......	......
.819	.708	.822	.783	SE....	NE....	NE....	4	12	12	8.0	N. 53 E.		1	0	0	......	......
.958	.822	.843	.874	NW ...	SW ...	NE....	12	2	4	4.0	N. 36 W.		0	1	0	......	......
.914	.647	.798	.786	Calm ..	W......	S......	0	12	12	5.7	S. 45 W.		1	0	0	......	......
.729	.690	.714	.711	SE....	Calm ..	S......	2	0	4	2.0	S. 14 E..		0	0	0	......	......
.733	.938	.561	.744	S......	SE....	W......	25	45	60	21.0	S. 27 W.		3	7	6	......	......
.917	.747	.790	.795	W	NE....	SE....	25	25	4	5.0	N. 19 W.		0	2	1	......	.13
.743	.751	.602	.699	SE....	S......	SW ...	12	4	25	10.7	S. 18 W.		6	7	10	......	......
.856	.926	.890	.891	NE....	NE....	NE....	25	45	4	24.7	N. 45 E.		10	6	10	......	.32
.820	.854	.863	.846	NW ...	NW ...	W....	90	60	60	66.0	N. 57 W.		10	10	10	......	.82
1.000	.893	.945	.946	NW ...	NE....	NW ...	35	60	35	30.7	N. 5 E..		10	10	10	......	.08
.948	.750	.947	.882	NW ...	NE....	NW ...	35	12	2	13.0	N. 27 W.		10	7	5	......	......
1.000	.845	.845	.897	NE....	NE....	NE....	2	4	4	3.3	N. 45 E.		8	9	8	......	......
.895	.820	.792	.836	NE....	NE....	NE....	4	25	25	18.0	N. 45 E.		10	6	2	......	......
1.000	.816	.898	.905	NE....	NE....	NE....	12	25	25	20.7	N. 45 E.		6	3	5	......	......
.849	.953	.910	.904	NE....	N	NW ...	4	2	45	12.0	N. 36 W.		8	10	10	......	......
.849	.895	.895	.880	W......	SE....	NE...	25	12	12	2.7	West ...		8	9	10	......	1.05
.948	.669	.945	.854	N	NW ...	NW ...	45	60	35	43.7	N. 31 W.		8	9	10	......	.90
.876	1.000	.946	.941	W......	S......	NE....	12	12	4	4.3	S. 45 W.		5.	9	10	......	.09
.837	.758	.808	.799	....	....	....	.....	.....	....	1.0	N. 4 E..		5.3	4.9	4.0	......	3.8

Reductions of the monthly meteorological register of the survey of

Date.	Barometer reduced to temperature of 32° Fahr., expressed in United States inches and decimals.				TEMPERATURE—FAHRENHEIT.									VAPOR.			
					Wet bulb, or point of evaporation.			Dry bulb, or temperature of the open air.				Maximum.	Minimum.	Elasticity, in U. S. inches and decimals.			
	7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	Mean.			7 a. m.	2 p. m.	9 p. m.	Mean.
1866.					°	°	°	°	°	°	°	°	°				
Nov. 1	28.972	29.054	29.293	29.106	28.5	32	32	29	34	33.5	32.2	36	27	.151	.155	.162	.156
2	29.437	29.526	29.598	29.520	30	31	31	31	31.5	32	31.5	35.5	28	.155	.168	.162	.162
3	29.680	29.703	29.791	29.725	28	34.5	25	29	35	25	29.7	38	23.5	.142	.193	.135	.157
4	29.943	30.001	30.054	29.999	24	34	30	34.5	34.5	31	30.0	35	19	.123	.189	.155	.156
5	30.053	29.970	29.861	29.961	19	39	26.5	19.5	41	24	28.2	42	16.5	.097	.212	....	.155
6	29.694	29.525	29.464	29.561	34	46	46	37	48.5	48.5	44.7	52	16	.157	.278	.278	.236
7	29.395	29.208	29.216	29.273	42	57	52	44	60.5	55	56.5	62	36	.241	.419	.349	.336
8	29.203	29.182	29.196	29.194	42	51	46	43	57	47.5	49.2	59	47.5	.254	.295	.291	.280
9	29.302	29.367	29.361	29.343	38	42	30.5	42	44.5	31	39.2	48	30	.177	.234	.164	.192
10	29.390	29.338	29.272	29.333	27	36	38	27.5	40.5	38.5	35.5	41	20	.141	.153	.223	.172
11	29.218	29.236	29.324	29.259	35	33	33	36	35	57	42.7	39	32	.191	.162	....	.177
12	29.433	29.472	29.508	29.471	31	38.5	28	32	43	30	35.0	44	27	.162	.174	.130	.155
13	29.451	29.355	29.187	29.331	35	26	38.5	32.5	47.5	40	40.0	41	25	....	....	.214	.214
14	28.946	28.856	28.983	28.928	38	42	37	38.5	43	38	39.8	46	36	.223	.254	.207	.228
15	28.988	28.793	28.815	28.865	35.5	37.5	32.5	37	41	35	37.7	39.5	32	.188	.179	.152	.173
16	28.961	29.022	29.020	29.001	32.5	36	36	35	37	36.5	36.2	39	32	.152	.199	.205	.185
17	29.054	28.969	29.011	29.011	29	37	32	30.5	38	32.5	33.7	42.5	30	.143	.207	.175	.175
18	29.131	29.118	29.132	29.127	33	45.5	34	33	49	34.5	38.8	51	28.5	.188	.259	.189	.212
19	29.094	29.121	29.192	29.136	26.5	43	38	27	45	40	37.3	48	25	.138	.251	.203	.197
20	29.379	29.388	29.441	29.403	29	30	28	29	30	29.5	29.5	41.5	27	.160	.167	.136	.154
21	29.359	29.260	29.123	29.247	35	31.5	29	25.5	32	29	28.8	41.5	22.5	.129	.168	.160	.152
22	29.273	29.394	29.499	29.389	26	35	27.5	26	35	28	29.7	37	23	.141	.204	.144	.163
23	29.493	29.523	29.546	29.521	26.5	30	27.5	27	30.5	28.5	28.7	31.5	20	.138	.161	.139	.146
24	29.554	29.516	29.486	29.519	26	38	22	26.5	38.5	31	32.0	23	22.5	.135	.223	.015	.124
25	29.246	29.160	29.135	29.180	25	40	28.5	25	42.5	30.5	32.7	42	18	.135	.215	.133	.161
26	29.170	29.231	29.288	29.230	28	40.5	33.5	28.5	41	34	34.5	44	25.5	.148	.246	.185	.193
27	29.294	28.933	28.806	29.011	36	41	36.5	37	42	37.5	38.8	43	35	.199	.244	.203	.215
28	28.886	28.988	29.129	29.001	32	28	27	34	29	28.5	30.5	43	25.5	.155	.142	.130	.142
29	29.217	29.217	29.268	29.234	25	24	24.5	25	25	25.5	25.2	29	22.5	.135	.117	.120	.124
30	29.336	29.399	29.468	29.404	25	24	21	25	26	23	24.7	28	21	.135	.106	.090	.110
Means...	29.318	29.294	29.315	29.309	....	....	....	31.2	39.2	34.5	35.0	....	.....	.154	.199	.161	.180
Dec. 1	29.428	29.231	29.146	29.268	17.5	32	35	18.5	36	35.5	30.0	37	13	.085	.129	.197	.137
2	29.063	28.967	29.002	29.011	26	43	36	26.5	48	38	37.5	50	23	.135	.212	.186	.178
3	28.762	28.761	28.812	28.778	38	37	32	39	38	33	36.7	41	31.5	.216	.207	.168	.197
4	28.955	29.012	29.222	29.063	33	33.5	32.5	34	35	33	37.3	37	29.5	.175	.172	.178	.175
5	29.407	29.538	29.621	29.522	23	36	26	24	39	25	29.3	41	22	.112	.173	....	.143
6	29.474	29.315	29.214	29.334	20	36	36	20.5	38	38	32.2	42	18.5	.102	.186	.186	.158
7	29.149	28.982	29.017	29.049	29	46	36	31	51.5	37	39.8	53	26	.137	.238	.199	.191
8	29.923	29.879	29.951	29.918	23	23	21	25	25	21.5	28.3	39	19	.100	.100	.107	.102
9	29.915	28.998	29.024	28.979	9	10	12.5	10	11	15	12.0	23	6.5	.054	.057	.048	.053
10	29.084	29.108	29.181	29.124	18	12.5	11	18.5	13	11	14.2	20	6	.093	.070	.071	.078
11	29.159	29.207	29.276	29.214	9.5	1.3	12	10	14	12.5	12.2	16	5	.060	.067	.069	.065
12	29.383	29.441	29.524	29.449	9.5	12	12	10	13	13	12.0	15.5	7	.060	.063	.063	.062
13	29.563	29.638	29.737	29.646	9	14	13.5	10	15	15	13.3	16.5	9	.054	.071	.063	.063
14	29.843	29.908	29.878	29.876	11.5	16	13	12	18	14	14.7	23	9	.067	.067	.067	.067
15	29.782	29.691	29.585	29.686	5	18	12.5	5	20	13	12.7	25	1	.055	.076	.070	.067
16	29.410	29.347	29.337	29.365	10	22	21	11	23.5	22	18.8	25	0	.057	.101	.101	.086
17	29.267	29.250	29.274	29.264	24	17	22	25	18	24	22.3	28	19.5	.117	.083	.095	.098
18	29.241	29.206	29.319	29.255	23	25	27	24	26.5	28.5	26.3	30	21	.112	.118	.130	.120
19	29.483	29.779	29.824	29.695	22	15	8	23	15.5	9	15.8	30	8	.107	.080	.051	.079
20	29.866	29.635	29.497	29.666	-7	18.5	19.5	-8	21	20.5	11.2	22	-11.5	....	.072	.093	.083
21	29.447	29.279	29.088	29.271	23	24.5	30	24	25.5	31	26.8	31	18	.112	.119	.155	.129
22	28.824	28.637	28.692	28.717	32.5	38	37	34	40	38	37.3	40	29	.165	.203	.207	.192
23	28.729	28.754	28.890	28.791	31	29.5	20	32.5	31	22	28.5	39	18.5	.157	.146	.085	.129
24	28.945	29.017	29.099	29.020	12	12	12	13.5	13.5	13.5	13.5	29	9	.058	.058	.058	.058
25	29.165	29.162	29.143	29.157	11	17	14	12	19	15	15.3	21.5	6.5	.061	.071	.071	.068
26	29.133	29.195	29.332	29.220	15	11.5	10	16	12	10.5	12.8	19	7	.074	.067	.062	.068
27	29.453	29.532	29.658	29.548	10	9	10	10	10	10	10.0	12	5.5	.068	.054	.068	.063
28	29.748	29.720	29.670	29.713	8	9	7	9	10	7.5	08.8	10	4	.051	.054	.054	.053
29	29.641	29.551	29.515	29.569	5.5	4	-2	6	5	-2	03.0	9	-6	.050	.041	.039	.043
30	29.475	29.355	29.267	29.366	-9	1	5	-9	2	5.5	-00.5	6	-14	.028	.034	.049	.037
31	29.265	29.390	29.541	29.399	10	12.5	85	10	14	9	11.0	15	1	.068	.059	.058	.062
Means...	29.322	29.306	29.333	29.320	....	....	....	17.0	22.6	20.0	19.9	....	.....	.093	.105	.101	.100

the northern and northwestern lakes at Ontonagon, Michigan.

VAPOR.				WIND.									Amount of cloudiness. (0=clear sky.) (10=sky entirely overcast.)			Amount of evaporation, in U. S. inches and decimals.	Amount of rain or melted snow, in U. S. inches and decimals.
Humidity. Saturation = 1,000.				Direction. From whence.			Velocity, in miles, per hour.			Resultant velocity, in miles, per hour.	Resultant direction.						
7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.			7 a. m.	2 p. m.	9 p. m.			
											°						
.944	.792	.841	.859	NE....	NE....	NW ...	4	35	35	17.7	N. 3 E..	10	8	10	......	.15
.893	.948	.896	.912	NW ...	N.W ...	NW ...	45	60	35	46.3	N. 45 W.	8	9	10	......	......
.887	.948	1.000	.945	NW ...	NE....	S......	12	4	12	2.0	N. 82 W.	4	5	0	......	......
.936	.948	.893	.926	SW ...	NE...	NE....	12	4	12	1.3	N. 45 E.	0	7	8	......	......
.924	.824	......	.874	S	S	Calm ..	4	4	0	2.7	South ..	0	0	0	......	......
.712	.815	.815	.781	S	S	S	12	12	4	9.3	South ..	7	7	10	......	......
.836	.795	.805	.812	S	S	S	12	12	12	12.0	South ..	7	5	8	......	......
.916	.634	.886	.812	W	W	W	12	25	12	16.3	West ...	0	0	0	......	.44
.661	.798	.947	.802	W	W	W	25	12	4	13.7	West ...	0	0	0	......	......
.941	.605	.953	.833	S	S	S	12	4	12	9.3	South ..	3	7	10	......	......
.900	.797	......	.848	W	W	W	25	35	12	24.0	West ...	10	7	8	......	.52
.896	.627	.782	.768	SW ...	SE	S	12	12	4	7.0	South ..	6	0	0	......	......
......	......	.864	.864	S	S	S	12	25	35	24.0	South ..	4	8	10	......	......
.953	.916	.905	.925	S	SW ...	W	2	4	25	9.3	S. 80 W.	4	10	10	......	.11
.854	.695	.747	.765	W	SE	Calm ..	12	4	0	3.3	S. 74 W.	8	8	0	......	.45
.747	.903	.950	.867	W	NE....	S	4	4	4	0.7	S. 45 W.	9	2	0	......	......
.839	.905	.945	.896	S	SW ...	S	12	4	4	6.3	S. 8 W..	2	9	5	......	......
1.000	.745	.948	.898	S	W	S	4	12	12	6.7	S. 37 W.	2	3	2	......	.04
.940	.840	.820	.867	S	S	NE....	4	12	25	6.0	N. 85 E.	4	2	3	......	......
1.009	1.000	.834	.945	NE....	NE....	S	35	12	12	13.3	N. 58 E.	10	8	3	......	......
.938	.948	1.000	.965	S	S	S	4	4	2	3.3	South ..	3	10	10	......	......
1.000	1.000	.942	.981	SW ...	NE....	S	2	12	4	2.7	N. 67 E.	8	5	8	......	.05
.940	.947	.885	.991	S	NE....	NW ...	12	12	45	12.3	N. 39 W.	7	6	8	......	......
.940	.953	.088	.660	NW ...	W	N	45	25	12	24.0	N. 52 W.	9	3	3	......	......
1.000	.789	.785	.858	S	S	S	25	25	4	18.0	South ..	4	3	4	......	......
.943	.955	.947	.948	S	NE....	NE....	12	4	12	3.7	N. 86 E.	3	5	5	......	......
.903	.914	.904	.907	NE....	NE....	NE....	25	12	12	16.3	N. 45 E.	10	10	10	......	......
.792	.887	.829	.836	NE ...	NE....	NE....	25	12	35	24.0	N. 45 E.	10	8	10	......	.22
1.000	.872	.874	.915	NE ...	NW ...	NE....	12	25	35	17.7	N. 17 E.	10	10	10	......	.10
1.000	.754	.730	.828	N	N	N	25	12	4	13.7	North ..	10	6	10	......	.22
.874	.819	.851	.869	....	....	....	....	....	....	2.9	N. 61 W.	5.7	5.7	5.8	......	2.30
.842	.610	.949	.800	S	S	S	25	4	12	13.7	South ..	6	3	5	......	......
.940	.631	.811	.794	S	S	S	4	4	12	6.7	South ..	0	0	6	......	......
.907	.905	.893	.902	S	W.....	S	12	12	12	9.0	S. 27 W.	10	8	0	......	.14
.895	.847	.946	.896	W	W	W	12	25	12	16.3	West ...	7	3	10	......	......
.868	.726	......	.797	S	W	S	4	12	4	5.0	S. 57 W.	0	0	0	......	......
.926	.811	.811	.849	S	S	S	4	4	25	11.0	South ..	4	3	0	......	......
.788	.626	.903	.772	S	S	W	12	12	12	9.0	S. 27 W.	0	0	10	......	......
.746	.746	.929	.807	N	NE....	NW ...	45	25	25	26.8	North ..	8	7	10	......	.03
.791	.797	.560	.716	W	W	W	45	35	35	38.3	West ...	10	10	10	......	.24
.921	.905	1.000	.907	W	W	W	35	45	12	30.7	West ...	10	10	10	......	.06
.896	.816	.904	.872	SW ...	SW ...	W	35	35	45	35.7	S. 62 W.	10	10	10	......	.30
.896	.810	.810	.839	W	W	W	35	25	12	24.0	West ...	8	7	5	......	.08
.791	.823	.734	.783	NE....	S	NW ...	12	4	12	4.3	North ..	8	9	3	......	.03
.902	.682	.816	.800	S	S	S	12	12	4	9.3	South ..	7	7	7	......	.06
1.000	.702	.905	.869	S	NE....	Calm ..	4	12	0	3.3	N. 62 E.	0	7	8	......	......
.797	.800	.860	.819	S	S	S	4	12	4	6.7	South ..	8	7	7	......	......
.872	.840	.738	.817	NE ...	NE ...	S	12	12	12	6.0	N. 74 E.	1	8	0	......	.03
.868	.818	.829	.838	S	S	NE ...	12	25	25	8.7	S. 42 E.	10	9	8	......	.10
.864	.913	.784	.854	NE ...	NE ...	Calm ..	25	25	0	16.7	N. 45 E.	10	10	0	......	......
......	.641	.852	.747	S	S	S	12	25	4	13.7	South ..	0	0	0	......	......
.868	.874	.893	.878	S	S	S	12	4	12	9.3	South ..	6	6	8	......	......
.843	.820	.905	.856	S	S	S	12	12	12	12.0	South ..	8	7	7	......	......
.848	.841	.721	.803	SW ...	NW ...	NW ...	35	35	35	24.7	N. 65 W.	0	8	0	......	......
.721	.721	.721	.721	NW ...	NW ...	NW ...	45	35	35	38.3	N. 45 W.	8	8	0	......	.02
.804	.692	.823	.773	SW ...	Calm ..	S	12	0	12	7.3	S. 23 W.	7	5	0	......	.03
.829	.902	.898	.876	NW ...	NW ...	NW ...	35	35	35	35.0	N. 45 W.	8	8	0	......	.11
1.000	.791	1.000	.730	N	N	N	35	25	25	28.3	North ..	0	8	6	......	.07
.784	.791	.886	.820	NE....	NW ...	NW ...	25	12	12	11.3	N. 1 E..	7	7	7	......	.08
.879	.750	1.000	.876	NW ...	SW ...	SW ...	35	35	12	19.3	S. 82 W.	0	0	0	......	.08
1.000	.718	.877	.862	S	S	S	4	4	4	4.0	South ..	0	7	2	......	.10
1.000	.725	.892	.872	S	S	W	12	12	35	14.3	S. 56 W.	8	0	0	......	.05
.869	.776	.855	.824	....	....	....	....	....	....	7.5	N. 89 W.	5.4	5.9	4.5	......	1.61

Reductions of the monthly meteorological register of the survey of

Date.	Barometer reduced to temperature of 32° Fahr., expressed in United States inches and decimals.				TEMPERATURE—FAHRENHEIT.										VAPOR.			
					Wet bulb, or point of evaporation.			Dry bulb, or temperature of the open air.				Maximum.	Minimum.	Elasticity, in U. S. inches and decimals.			
	7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	Mean.			7 a. m.	2 p. m.	9 p. m.	Mean.
1866.					°	°	°	°	°	°	°	°	°				
July 1	29.298	29.278	29.268	29.281	61	62.5	56.5	68.5	76	60.5	68.3	81	59	.436	.519	.402	.452
2	29.261	29.172	29.105	29.179	60	69	64	64.5	83.5	72.5	73.5	84.5	56.5	.458	.648	.499	.535
3	28.962	28.882	28.872	28.905	62.5	67	61.5	67.5	69.5	62.5	66.5	80.5	62.5	.499	.628	.525	.551
4	28.920	28.950	28.950	28.940	61.5	64	60.5	68	72.5	65	68.5	79	54.5	.459	.483	.467	.470
5	28.975	28.939	28.990	28.968	64.5	76	67	70.5	91	72	77.8	91	63	.519	.705	.595	.606
6	29.050	28.966	29.002	29.006	64	78.5	70.5	68.5	96	73.5	79.3	97.5	56	.536	.737	.698	.657
7	29.102	29.102	29.180	29.128	64.5	67	55.5	70	78	62	70.0	85.5	59	.533	.514	.355	.467
8	29.324	29.443	29.475	29.414	54.5	54.5	49.5	60	62.5	53.5	58.7	68.5	52	.352	.327	.294	.324
9	29.466*	29.474	29.448	29.463	57	59	57	63	66.5	64.5	64.7	67.5	43	.386	.400	.366	.384
10	29.431	29.327	29.298	29.352	59	71	65.5	65	88	74	75.7	90	57	.420	.529	.514	.488
11	29.347	29.243	29.219	29.270	67	76	69.5	75	97	82	84.7	99.5	64	.554	.613	.464	.544
12	29.217	29.222	29.230	29.223	73	74.5	73	82.5	84.5	78.5	81.8	98.5	75	.683	.711	.737	.710
13	29.232	29.242	29.255	29.243	68.5	72.5	66.5	72	79.5	69.5	70.3	81.5	68	.649	.696	.598	.648
14	29.240	29.145	29.125	29.170	69.5	77.5	66.5	73.5	94.5	70	79.3	97.5	66.5	.660	.705	.603	.656
15	29.079	29.144	29.210	29.144	74.5	75.5	67.5	84.5	84.5	70	79.7	94.5	66	.711	.754	.639	.701
16	29.175	29.216	29.257	29.216	69.5	76.5	72.5	72.5	87.5	79	79.7	92	66	.673	.519	.709	.634
17	29.370	29.398	29.348	29.339	62.5	60	58.5	70	67	61	66.0	72.5	59	.465	.425	.458	.449
18	29.351	29.358	29.344	29.351	59	64.5	55.5	64	74	60	63.3	75	54	.433	.479	.381	.431
19	29.373	29.215	29.283	29.290	58.5	68.5	60.5	65	80	68	71.0	82.5	52	.404	.542	.427	.458
20	29.283	29.283	29.218	29.225	65	71.5	64	73	81.5	69	74.5	85.5	63.5	.510	.616	.529	.552
21	29.170	29.145	29.162	29.159	65	68	64.5	72	70.5	67.5	70.0	83	62.5	.524	.651	.566	.580
22	29.135	29.126	29.282	29.181	63.5	58	52.5	67	61.5	55.5	61.3	72	53	.543	.444	.349	.445
23	29.292	29.276	29.269	29.279	54.5	63.5	55	57	70.5	57	61.5	71	52	.392	.492	.407	.430
24	29.246	29.266	29.288	29.267	61	67	62	64	77.5	65	68.8	80	55	.497	.594	.516	.536
25	29.266	29.391	29.368	29.342	62.5	66.5	60.5	64.5	74	63	67.2	77	58.5	.539	.550	.494	.528
26	29.296	29.298	29.263	29.286	63.5	....	65.5	67.5	78	70	71.8	84	56.5	.532	....	.568	.550
27	29.320	29.267	29.238	29.275	71	76	64.5	76.5	87.5	68	77.3	92.5	63.5	.684	.741	.559	.661
28	29.295	29.292	29.256	29.281	66.5	68	61.5	71	78	65.5	71.5	83	61	.590	.550	.492	.544
29	29.178	29.240	29.268	29.229	65	66	59.5	71.5	78	62	70.5	75	59.5	.530	.478	.476	.495
30	29.324	29.321	28.885	29.177	60.5	68.5	61	63.5	76.5	66	68.7	78	55.5	.487	.569	.473	.519
31	29.165	28.907	29.168	29.080	62	73.5	65	64.5	79	67	70.2	78.5	62	.522	.751	.591	.621
Means....	29.224	29.211	29.210	29.215	....	....	....	69.2	78.8	66.9	71.6	....	....	.522	.579	.508	.536
August 1	28.935	28.960	29.148	29.014	60.5	63	53	65.5	69	55	63.2	71.5	58	.459	.495	.376	.443
2	29.216	29.285	29.249	29.250	56.5	61.5	58	61.5	71	63	65.2	73	52.5	.391	.418	.416	.408
3	29.251	29.281	29.336	29.289	60	56.5	53	62	58.5	60	60.2	63.5	53.5	.491	.430	.310	.410
4	29.459	29.501	29.469	29.476	56.5	59	54.5	58.5	69	61	62.8	70	50	.430	.367	.339	.379
5	29.518	29.526	29.484	29.509	57.5	64	55.5	66.5	73.5	60	66.7	73.5	52.5	.354	.469	.381	.401
6	29.483	29.456	29.414	29.451	58.5	65	54.5	65.5	73	57	65.2	76	53.5	.398	.611	.392	.467
7	29.398	29.368	29.346	29.371	59	64.5	57.5	66	73.5	61	66.8	75	52	.407	.486	.427	.440
8	29.249	29.218	29.222	29.230	58	60	56.5	58.5	61.5	69	63.0	62	56.5	.476	.498	.424	.466
9	29.196	29.276	29.329	29.267	58	61	55	60.5	65	56.5	60.7	72	54	.449	.483	.413	.448
10	29.352	29.321	29.324	29.332	57.5	65	60.5	61	72	65	66.0	75	52.5	.427	.524	.467	.473
11	29.298	29.273	29.266	29.279	62	68	65.5	65.5	76	70.5	70.7	84.5	59.5	.509	.577	.561	.549
12	29.158	29.148	29.173	29.160	62	61	56.5	63	63	57.5	61.2	64.5	55.5	.542	.510	.442	.498
13	29.229	29.246	29.160	29.212	58.5	66	62.5	59.5	69.5	64	64	72	54.5	.478	.592	.546	.559
14	29.081	29.360	29.476	29.306	63	64	56	67.5	72.5	59.5	66.5	73	57.5	.516	.483	.403	.467
15	29.617	29.656	29.624	29.632	51	58	46.5	56.5	65.5	50	57.3	67	48.5	.302	.383	.271	.319
16	29.574	29.475	29.443	29.497	53	69.5	60.5	58	82	66.5	68.8	83.5	43	.336	.553	.447	.445
17	29.358	29.378	29.368	29.368	60.5	67.5	57	65	72.5	60	65.5	78	58.5	.467	.601	.426	.498
18	29.347	29.331	29.321	29.333	54	61.5	53	57	68.5	57	60.8	70	51.5	.378	.452	.350	.393
19	29.313	29.298	29.246	29.286	55	62.5	57	60	71.5	55.5	65.7	72	50.5	.367	.445	.353	.388
20	29.143	29.178	29.172	29.164	54.5	58	52.5	59	59.5	54.5	57.7	62	52.5	.365	.463	.369	.399
21	29.196	29.234	29.237	29.222	51	47	43	52.5	49.5	45	49.0	52.5	43	.354	.290	.251	.298
22	29.232	29.244	29.276	29.251	45	48.5	46.5	47	52.5	49	49.5	51.5	43	.273	.288	.281	.281
23	29.287	29.248	29.239	29.258	46.5	48.5	46	49.5	52.5	47	49.7	52.5	44.5	.277	.288	.297	.287
24	29.257	29.193	29.292	29.247	46	51	48	47.5	54	50	50.5	54.5	43	.291	.335	.309	.312
25	29.2[illegible]2	29.005	29.195	29.151	49.5	59	53	53	66.5	58	59.2	67.5	47	.308	.400	.336	.348
26	29.015	29.217	29.065	29.099	57	62	53	61.5	69.5	56.5	62.3	79	54.5	.406	.456	.356	.406
27	29.148	29.217	29.201	29.189	49.5	57	47	52	63.5	49.5	55.0	64.5	46	.321	.379	.290	.330
28	29.222	29.234	29.242	29.233	47	58	48	50.5	65.5	49.5	55.2	66	40.5	.277	.383	.315	.325
29	29.235	29.198	29.212	29.215	52.5	60	52.5	55.5	60	55.5	59.0	68	45.5	.356	.438	.356	.383
30	29.225	29.234	29.194	29.218	52	59.5	48	56	66.5	50	57.5	68	45	.335	.416	.309	.353
31	29.131	29.058	28.985	29.058	48	62.5	63	48	67.5	66	60.5	69	43	.335	.499	.336	.457
Means....	29.270	29.278	29.281	29.276	....	....	....	58.4	66.4	57.4	60.7	....	....	.393	.452	.379	.408

the northern and northwestern lakes at Marquette, Michigan.

VAPOR.				WIND.									Amount of cloudiness. (0=clear sky.) (10=sky entirely overcast.)			Amount of evaporation, in U. S. inches and decimals.	Amount of rain or melted snow, in U. S. inches and decimals.
Humidity. Saturation = 1,000.				Direction. From whence.			Velocity, in miles, per hour.			Resultant velocity, in miles, per hour.	Resultant direction.						
7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.				7 a. m.	2 p. m.	9 p. m.		
											°						
.627	.812	.767	.735	Calm	S	S	0	35	4	13.0	South		6	4	4	......	......
.755	.786	.626	.722	Calm	S	S	0	25	12	12.3	South		4	4	8	......	......
.741	.872	.914	.842	SW	W	NW	12	2	2	4.7	S. 58 W.		4	0	0	......	.24
.672	.605	.757	.678	SW	SE	E	4	2	2	1.3	S. 8 E		0	2	0	......	......
.686	.479	.758	.641	SW	SW	Calm	12	12	0	8.0	S. 45 W.		8	4	10	......	......
.770	.434	.833	.679	Calm	SW	S	0	12	4	5.0	S. 34 W.		1	2	10	......	.59
.727	.537	.638	.634	W	W	W	4	4	4	4.0	West		0	2	0	......	.20
.680	.586	.705	.657	NW	NW	W	25	12	2	13.0	N. 47 W.		1	0	0	......	......
.670	.615	.603	.629	Calm	Calm	S	0	0	4	1.3	South		0	0	0	......	......
.680	.400	.613	.564	SE	S	S	4	12	2	5.7	S. 9 E		0	0	1	......	......
.639	.350	.506	.498	SW	S	S	12	12	2	8.0	S. 21 W.		0	0	0	......	......
.616	.591	.757	.655	W	SE	Calm	45	2	0	14.3	S. 88 W.		0	1	4	......	......
.828	.681	.823	.777	W	W	NW	2	2	2	2.0	N. 76 W.		8	2	10	......	.36
.787	.427	.823	.679	W	S	SW	2	12	2	4.7	S. 14 W.		5	0	0	......	.26
.591	.627	.972	.697	W	W	E	35	2	2	11.7	West		0	5	2	......	.39
.830	.524	.717	.690	NW	SW	SW	2	12	2	4.7	S. 53 W.		1	0	0	......	......
.635	.642	.853	.710	NW	NW	NW	2	4	2	2.7	N. 45 W,		8	6	2	......	......
.727	.572	.736	.678	NW	E	W	2	2	2	0.7	N. 45 W.		0	0	0	......	......
.655	.530	.624	.603	SE	E	S	4	25	4	9.0	S. 78 E.		0	1	0	......	......
.629	.546	.747	.641	Calm	SE	W	0	4	2	1.0	S. 15 E.		0	6	2	......	......
.668	.873	.842	.794	W	W	Calm	2	2	0	1.3	West		1	10	6	......	......
.815	.800	.778	.798	W	N	NW	2	12	4	5.0	N. 19 W.		4	9	10	......	......
.843	.660	.874	.792	Calm	E	Calm	0	4	0	1.3	East		10	10	10	......	......
.833	.630	.836	.766	E	E	NW	2	2	2	1.0	N. 63 E.		6	0	0	......	......
.889	.655	.858	.801	N	E	W	2	2	2	0.7	North		10	0	1	......	......
.791	......	.774	.782	SE	SE	Calm	2	2	0	1.3	S. 45 E.		2	4	0	......	......
.751	.569	.818	.713	S	E	Calm	4	2	0	1.7	S. 24 E.		4	1	0	......	......
.778	.574	.784	.712	N	E	NW	2	4	2	1.3	N. 33 E.		0	0	0	......	......
.688	.499	.856	.681	NW	NW	Calm	12	4	0	5.3	N. 45 W.		0	0	0	......	......
.832	.646	.735	.738	E	E	NW	2	2	2	1.0	N. 62 E.		10	1	10	......	......
.862	.758	.893	.838	S	S	NW	4	35	12	10.7	S. 15 W.		10	4	10	......	1.55
.732	.609	.765	.704	....	....	....	....	....	....	2.6	S. 46 W.		3.3	2.5	3.2	......	3.59
.733	.700	.869	.767	W	W	NW	12	25	4	13.3	N. 86 W.		0	2	10	......	.10
.715	.553	.723	.664	NW	NE	Calm	12	4	0	4.3	N. 26 W.		0	0	10	......	......
.884	.877	.599	.787	Calm	NW	NW	0	2	2	1.3	N. 45 W.		10	10	0	......	.33
.877	.518	.632	.676	NW	NW	NW	12	12	4	9.3	N. 45 W.		0	0	0	......	......
.546	.569	.736	.617	N	E	NW	4	4	2	2.0	N. 26 E		1	10	0	......	......
.633	.972	.843	.816	Calm	E	Calm	0	4	0	1.3	East		0	0	0	......	......
.636	.590	.796	.674	Calm	NE	NW	0	4	2	1.7	N. 16 E.		2	0	0	......	......
.969	.912	.849	.910	Calm	NW	SE	0	2	2	0	Calm		10	10	1	......	.29
.852	.783	.904	.846	NW	N	NW	4	12	2	5.7	N. 15 W.		3	2	10	......	......
.796	.668	.757	.740	S	NE	S	2	12	2	3.3	N. 61 E.		4	1	0	......	......
.811	.644	.752	.736	SE	E	S	4	12	4	5.3	S. 65 E.		1	2	0	......	......
.942	.886	.936	.921	NE	NE	N	12	4	4	6.3	N. 37 E.		10	10	10	......	1.29
.939	.822	.915	.892	N	E	E	4	2	2	2.0	N. 45 E.		10	10	10	......	.04
.766	.605	.791	.721	NW	NW	NW	12	12	4	9.3	N. 45 W.		0	0	0	......	......
.660	.609	.750	.673	NE	E	Calm	12	4	0	5.0	N. 56 E.		1	0	0	......	......
.698	.506	.687	.630	SW	SE	SW	35	12	25	20.3	S. 34 W.		0	2	0	......	......
.757	.759	.822	.779	W	SE	N	12	2	2	3.3	N. 86 W.		4	4	0	......	......
.812	.650	.752	.738	Calm	NE	Calm	0	12	0	4.0	N. 45 E.		3	0	1	......	......
.708	.579	.561	.616	N	E	Calm	4	4	0	2.0	N. 45 E		0	0	0	......	......
.731	.909	.868	.836	W	NW	N	4	12	4	6.0	N. 45 W.		4	6	8	......	.07
.897	.819	.840	.852	N	NW	W	4	4	4	3.0	N. 45 W.		7	7	4	......	.19
.847	.730	.817	.798	NW	N	N	4	12	12	9.0	N. 6 W.		4	6	6	......	.24
.783	.730	.923	.812	N	NW	NW	12	25	4	12.7	N. 32 W.		10	8	5	......	.40
.886	.802	.856	.848	NW	NW	NW	4	4	2	3.3	N. 45 W.		10	7	6	......	......
.765	.615	.698	.693	W	SE	NW	4	2	4	2.0	N. 72 W.		1	0	2	......	......
.743	.632	.780	.718	W	N	W	12	2	2	5.0	N. 79 W.		0	5	8	......	......
.827	.647	.819	.764	N	NE	NW	4	2	4	3.0	N. 9 W.		3	2	0	......	......
.753	.609	.890	.751	Calm	E	Calm	0	12	0	4.0	East		2	0	0	......	......
.807	.685	.807	.766	E	E	NW	2	12	2	4.3	N. 48 E.		4	2	6	......	......
.747	.639	.856	.747	E	E	NW	2	12	2	4.3	N. 84 E.		0	0	0	......	......
1.000	.741	.838	.860	Calm	SE	S	0	2	12	4.7	S. 6 E.		8	8	8	......	......
.791	.702	.796	.763	....	....	....	....	....	....	1.9	N. 32 W.		3.6	3.7	3.4	......	2.95

Reductions of the monthly meteorological register of the survey of

Date.	Barometer reduced to temperature of 32° Fahr., expressed in United States inches and decimals.				TEMPERATURE—FAHRENHEIT.									VAPOR.			
					Wet bulb, or point of evaporation.			Dry bulb, or temperature of the open air.				Maximum.	Minimum.	Elasticity, in U. S. inches and decimals.			
	7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	Mean.			7 a. m.	2 p. m.	9 p. m.	Mean.
1866.					°	°	°	°	°	°	°	°	°				
Sept. 1	28.905	28.887	28.953	28.915	66.5	72	54.5	69	76.5	56.5	67.3	78	55	.617	.724	.399	.580
2	29.016	28.985	29.135	29.045	54	60	53	57.5	70.5	59.5	62.5	72.5	50.5	.371	.378	.317	.322
3	29.204	29.224	29.228	29.215	53	63	58	59	76.5	64	66.5	78	52	.323	.395	.403	.374
4	29.135	29.055	29.100	29.097	57.5	56.5	51.5	61	57.5	53.5	54.0	61.5	51.5	.427	.437	.348	.404
5	29.153	29.153	29.236	29.181	51	61	55	54	72	58	61.3	72	46.5	.335	.390	.393	.373
6	29.312	29.302	29.248	29.287	51	61	53	55	65	55	58.3	75.5	48	.321	.483	.376	.393
7	29.209	29.151	29.143	29.168	54	58	53	57.5	62	55	58.2	69	53	.371	.429	.376	.392
8	29.222	29.332	29.458	29.337	52	56	52	53.5	60	54.5	56.0	60.5	50.5	.342	.396	.355	.364
9	29.537	29.547	29.472	29.519	53.5	57.5	49.5	56.5	62.5	52	57.0	66.5	50	.363	.407	.321	.364
10	29.396	29.286	29.216	29.299	51.5	61.5	52	55	71	54.5	60.2	74.5	47.5	.335	.419	.355	.370
11	29.108	28.953	28.858	28.973	52	55	55	54	57	57	56.0	60	50	.362	.407	.407	.392
12	28.704	28.736	28.916	28.785	49	52	47	53	56.5	51	53.5	58	49	.295	.329	.270	.298
13	29.103	29.141	29.181	29.142	46	48	42	49.5	52	45	48.8	59	42.5	.265	.282	.228	.258
14	29.174	29.312	29.380	29.289	41.5	40.5	36.5	43	45	40	42.7	47	38	.242	.193	.170	.202
15	29.440	29.378	29.212	29.343	39.5	52	50	43.5	63	55	53.8	64.5	36.5	.190	.243	.295	.243
16	29.101	29.198	29.294	29.198	53	48.5	41.5	56.5	50	44.5	50.3	60	42.5	.356	.321	.223	.300
17	29.350	29.329	29.284	29.321	39.5	47.5	42.5	43.5	56	46	48.5	58	38	.190	.217	.226	.211
18	29.277	29.292	29.326	29.298	40	47	37	42.5	55	40.5	46.0	38.5	38.5	.215	.217	.175	.202
19	29.375	29.418	29.482	29.425	38	48	39	42.5	54	41	45.8	55	36.5	.170	.256	.212	.216
20	29.450	29.424	29.389	29.421	39	43	41	43	47.5	44.5	45.0	48.5	35.5	.186	.219	.211	.205
21	29.368	29,386	29.381	29.378	37	46	37.5	38.5	50.5	39.5	42.8	52.5	36	.201	.252	.198	.217
22	29.382	29.306	29.318	29.335	38.5	46.5	48	42	53.5	51.5	49.0	53.5	32.5	.187	.225	.289	.234
23	29.320	29.279	29.256	29.285	47	51	49	50	56.5	52	52.8	57	47.5	.283	.302	.308	.298
24	28.871	28.890	29.236	28.999	53.5	54.5	47.5	55.5	59	50.5	55.0	64	46.5	.383	.365	.289	.346
25	29.332	29.301	29.311	29.315	41	54	48	44	62	53.5	53.2	64.5	37.5	.218	.312	.263	.264
26	29.230	29.198	29.342	29.257	46	57	46	53.5	66.5	48	56 0	74	46	.212	.339	.284	.278
27	29.394	29.345	29.266	29.335	48	69	57	52.5	76.5	65	64.7	78	42	.276	.608	.359	.414
28	29.303	29.170	29.261	29.245	58.5	67.5	59.5	64.5	82	67	71.2	82	60	.411	.478	.409	.433
29	29.365	29.556	29.594	29.505	58	53	41	65	61	45	57.0	68	43.5	.389	.297	.205	.297
30	29.590	29.461	29.358	29.470	43	58	55	47	72	64.5	61.2	74	40	.225	.296	.307	.276
Means....	29.244	29.233	29.261	29.246	....	....	....	52.0	61.3	52.6	55.3	....	....	.302	.354	.299	.318
Oct. 1	29.306	29.092	29.128	29.175	53.5	68	62	57	84.5	71.5	71.0	85	51	.370	.463	.429	.421
2	29.337	29.436	29.476	29.416	44.5	45.5	38	48.5	50.5	40	46.3	51	39	.241	.239	.203	.228
3	29.435	29.389	29.456	29.427	40	42	42.5	42.5	44	45	43.8	45	37	.215	.241	.239	.232
4	29.573	29.606	29.659	29.613	40	49	40	42.5	55	43.5	47.0	58	39	.215	.269	.202	.229
5	29.670	29.586	29.512	29.589	45	54	49	45	61	52	52.7	61	34.5	.299	.325	.308	.311
6	29.440	29.315	29.285	29.347	50	63	62	54.5	72.5	70	65.7	76	50	.301	449	.449	.409
7	29.313	29.277	29.223	29.271	60	68.5	61.5	67.5	83	70.5	73.7	84.5	65	.418	.512	.633	.521
8	29.118	29.154	29.151	29.141	60	55.5	53.5	64	57.5	56	59.2	71.5	54.5	.465	.114	.314	.298
9	29.212	29.261	29.344	29.272	42	49	46	43.5	51	48	47.5	53.0	42	.247	.321	.284	.284
10	29.402	29.441	29.488	29.444	42	51	45	43.5	54.5	47	48.3	56	41.5	.247	.328	.273	.283
11	29.487	29.441	29.414	29.447	42	52	45	44	57	46	49.0	54	40	.241	.322	.286	.283
12	29.407	29.338	29.323	29.356	55	57	51	60	64	52.5	58.8	65	38.5	.367	.373	.354	.365
13	29.374	29,385	29.443	29.401	47	62	51.5	48	70.5	54	57.5	71	46.5	.310	.442	.348	.367
14	29.582	29.626	29.701	29.636	47.5	58.5	51.5	50	66	54	56.7	66.5	44	.283	.391	.348	.341
15	29.810	29.799	29.776	29.795	47.5	62	52.5	49.5	70	57	58.8	71.5	46	.303	.449	.336	.363
16	29.747	29.645	29.566	29.653	47	63	51	50	71	54	58.3	72.5	48	.283	.469	.335	.362
17	29.455	29.331	29.248	29.345	44	62	51.5	47	69	58	38.0	70.5	44	.249	.462	.295	.335
18	29.138	28.912	28.960	29.003	49.5	64.5	60.5	54.5	72	61.5	62.7	70	47	.288	.504	.514	.435
19	29.118	29.180	29.264	29.189	47	57	47.5	55	64	51.5	56.8	73	43	.217	.280	.276	.258
20	29.272	29.198	29.095	29.188	45	53	54	48.5	60.5	56.5	55.2	61.5	45.5	.253	.303	.385	.314
21	28.873	28.750	28.510	28.711	51	53	53	56	54	55	55.0	57	51	.308	.389	.376	.358
22	28.434	28.642	28.762	28.613	37.5	39	33.5	38.5	43	36.5	41.0	44	35	.211	.186	.153	.183
23	28.864	29.088	29.287	29.080	32	35	33	34	32	35	33.7	35.5	31	.155	....	.162	.159
24	29.357	29.363	29.357	29.359	31	33	31	32	35.5	32.5	33.3	39	29.5	.162	.156	.157	.158
25	29.332	29.266	29.236	29.278	31.5	34.5	35	32	36.5	36.5	35.0	39	29	.170	.174	.184	.176
26	29.126	29.135	29.228	29.163	36	38	35	38	40	36.5	38.2	41	34.5	.186	.203	.184	.191
27	29.377	29.391	29.359	29.376	33.5	38.5	37.5	35	39	38	37.3	40	31	.172	.226	.218	.205
28	29.061	28.878	28.878	28.939	38	34.5	39	38	39.5	40	39.2	45.5	36	.229	.135	.225	.196
29	29.046	29.043	29.030	29.040	34	40	36	35.5	44	37	38.8	45.5	33.5	.176	.195	.199	.190
30	29.116	29.226	29.309	29.217	32.5	29.5	29	33.5	31	30.5	31.7	34	28.5	.171	.140	.143	.154
31	29.401	29.266	29.150	29.272	23	29	28	25	31	30.5	28.8	33	22.5	.100	.137	.125	.121
Means....	29.296	29.270	29.278	29.282	....	....	....	45.5	54.9	48.3	49.6	....	....	.253	.327	.288	.281

the northern and northwestern lakes at Marquette, Michigan.

VAPOR.				WIND.								Amount of cloudiness. (0 = clear sky.) (10 = sky entirely overcast.)			Amount of evaporation, in U. S. inches and decimals.	Amount of rain or melted snow, in U. S. inches and decimals.
Humidity. Saturation = 1,000.				Direction. From whence.			Velocity, in miles, per hour.			Resultant velocity, in miles, per hour.	Resultant direction.					
7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.			7 a. m.	2 p. m.	9 p. m.		
.871	.794	.873	.846	....	S	NW	....	4	2	1.0	S. 28 W.	....	9	0	......	.25
.784	.507	.623	.638	SW	W	NW	12	4	4	5.3	S. 70 W.	6	0	0	......	......
.647	.434	.675	.585	W	W	N	12	12	2	8.3	N. 85 W.	1	1	10	......	......
.799	.906	.834	.846	W	NW	N	2	12	2	5.0	N. 45 W.	6	6	0	......	.60
.802	.497	.816	.705	W	W	Calm	4	4	0	2.7	West	0	3	0	......	......
.743	.783	.869	.798	Calm	E	NW	0	2	4	1.0	N. 15 W.	1	4	0	......	......
.784	.772	.869	.808	Calm	N	NW	0	12	2	4.7	N. 6 W.	1	5	1	......	.10
.776	.765	.836	.792	N	N	N	2	25	2	9.7	North	1	2	2	......	......
.782	.720	.827	.776	NW	NE	....	2	4	....	1.7	N. 16 E.	2	6	1	......	......
.774	.553	.836	.721	W	E	Calm	2	4	0	0.7	East	0	2	0	......	......
.867	.874	.874	.872	Calm	E	E	0	2	2	1.3	East	10	10	10	......	.50
.733	.719	.722	.725	W	NW	W	35	25	25	26.3	N. 77 W.	0	4	0	......	......
.748	.727	.762	.746	W	NW	NW	12	4	2	5.7	N. 74 W.	0	0	0	......	......
.874	.645	.688	.736	NW	NW	Calm	45	25	0	23.3	N. 45 W.	10	4	3	......	.21
.673	.422	.681	.592	W	SE	W	4	25	45	12.0	S. 61 W.	3	0	0	......	......
.780	.891	.759	.810	S	NW	SW	4	4	4	2.3	S. 54 W.	8	3	0	......	......
.673	.283	.729	.562	W	W	W	2	4	2	2.7	West	1	6	0	......	......
.789	.502	.692	.661	W	W	W	2	2	2	2.0	West	2	2	5	......	......
.623	.613	.824	.687	W	E	NW	4	2	2	1.3	N. 69 W.	0	5	0	......	......
.669	.663	.720	.684	NW	N	NW	2	4	2	2.3	N. 24 W.	8	8	7	......	......
.860	.683	.818	.787	NW	Calm	W	2	0	2	1.3	N. 69 W.	2	4	0	......	......
.702	.548	.758	.669	S	S	S	12	35	12	19.7	South	8	8	1	......	......
.786	.660	.794	.747	SE	SE	SE	12	25	4	13.7	S. 45 E.	8	7	5	......	......
.870	.731	.798	.796	SE	SW	W	35	60	2	23.3	S. 16 W.	9	2	0	......	.49
.756	.561	.640	.652	NW	E	E	2	4	4	2.3	N. 78 E.	1	1	0	......	......
.518	.522	.850	.630	S	SW	W	45	12	2	18.0	S. 11 W.	1	1	0	......	......
.696	.666	.582	.648	S	S	S	2	4	25	10.3	South	0	0	0	......	......
.677	.438	.618	.578	SW	SW	SW	45	35	25	35.0	S. 45 W.	0	0	0	......	......
.631	.553	.684	.623	W	W	W	2	4	2	2.7	West	0	0	0	......	......
.698	.378	.507	.561	Calm	S	W	0	12	45	15.7	S. 75 W.	0	0	0	......	......
.745	.627	.751	.708	....	....	....	....	....	....	4.8	S. 60 W.	2.9	3.4	1.2	......	2.15
.810	.391	.556	.586	S	SW	W	2	45	4	16.3	S. 47 W.	0	1	0	......	......
.707	.649	.820	.725	NW	N	NW	25	25	4	17.0	N. 24 W.	9	1	0	......	......
.789	.836	.800	.808	S	SE	NW	2	2	2	0.7	South	10	7	10	......	.05
.789	.620	.713	.707	E	E	E	2	4	2	2.7	East	5	4	0	......	......
1.000	.606	.794	.800	S	S	S	12	12	2	8.7	South	1	6	0	......	......
.709	.563	.613	.628	SE	SW	S	2	12	12	7.7	S. 81 W.	4	4	0	......	......
.621	.444	.849	.638	SW	S	S	4	4	12	6.3	S. 8 W.	4	3	0	......	......
.780	.875	.840	.832	S	SE	S	2	2	2	2.1	S. 13 E.	4	7	10	......	.50
.875	.859	.850	.861	NW	Calm	W	2	0	2	1.3	N. 69 W.	7	7	7	......	......
.875	.772	.847	.831	Calm	N	W	0	4	2	1.7	N. 24 W.	7	4	0	......	......
.836	.692	.921	.816	NW	E	W	2	2	2	0.7	N. 45 W.	0	0	10	......	......
.708	.625	.897	.743	Calm	S	SE	0	4	2	2.0	S. 14 E.	0	0	0	......	......
.925	.593	.834	.784	E	S	SE	2	4	2	2.3	S. 32 E.	7	0	0	......	......
.786	.612	.834	.744	Calm	E	Calm	0	2	0	0.7	East	0	0	0	......	......
.854	.613	.722	.730	S	S	S	2	2	4	2.7	South	0	7	0	......	......
.786	.618	.803	.735	Calm	SE	Calm	0	4	0	1.3	S. 45 E.	0	0	0	......	......
.772	.653	.612	.679	Calm	Calm	S	0	0	4	1.3	South	0	1	7	......	......
.677	.645	.941	.754	S	S	S	12	45	2	19.7	South	2	2	8	......	......
.503	.369	.724	.532	W	W	S	2	4	4	2.3	S. 60 W.	0	0	7	......	......
.743	.576	.842	.720	S	S	S	4	35	2	13.7	South	6	6	10	......	......
.687	.933	.869	.830	Calm	Calm	S	0	0	12	4.0	South	7	7	8	......	1.51
.906	.669	.708	.761	NW	W	W	25	25	25	23.3	N. 75 W.	6	6	6	......	......
.792	......	.797	.795	NW	NW	NW	12	12	4	9.3	N. 45 W.	5	5	10	......	.40
.896	.750	.848	.831	NW	W	S	4	2	12	3.7	S. 26 W.	8	5	6	......	......
.948	.804	.853	.868	SE	E	SE	12	25	12	15.3	S. 68 E.	5	5	10	......	.13
.811	.820	.853	.828	NE	NE	NE	25	25	12	20.7	N. 45 E.	9	9	5	......	.25
.847	.953	.952	.917	N	SE	SE	12	4	45	13.7	S. 57 E.	10	6	10	......	.34
1.000	.552	.910	.821	NE	E	W	25	12	25	6.0	N. 15 E.	10	10	10	......	.20
.849	.677	.903	.810	Calm	W	NW	0	2	2	1.3	N. 70 W.	4	1	10	......	......
.894	.841	.839	.858	NW	NW	NW	12	12	12	12.0	N. 45 W.	10	10	10	......	.61
.746	.788	.733	.756	NW	W	SW	12	4	12	7.0	West	6	8	10	......	......
.807	.680	.809	.765	....	....	....	....	....	....	1.5	S. 31 W.	4.8	4.3	5.3	......	3.99

Reductions of the monthly meteorological register of the survey of

Date.	Barometer reduced to temperature of 32° Fahr., expressed in United States inches and decimals.				TEMPERATURE—FAHRENHEIT.									VAPOR.			
					Wet bulb, or point of evaporation.			Dry bulb, or temperature of the open air.				Maximum.	Minimum.	Elasticity, in U. S. inches and decimals.			
	7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	Mean.			7 a. m.	2 p. m.	9 p. m.	Mean.
1866.					°	°	°	°	°	°	°	°	°				
Nov. 1	28.966	28.865	29.202	29.011	29	33.5	30	30.5	33.5	31.5	32.5	37	28.5	.143	.166	.150	.153
2	29.410	29.431	29.512	29.451	27.5	30.5	27.5	29	32	28.5	29.8	33.5	26	.133	.153	.139	.142
3	29.544	29.586	29.725	29.618	27	31.5	24.5	28	34	26.5	29.5	40.5	29.5	.136	.147	.109	.131
4	29.852	29.938	29.994	29.928	28.5	31	29	32	34.5	32	32.8	35.5	24	.116	.135	.126	.126
5	30.002	29.947	29.817	29.922	27	34	31	29.5	37.5	32.5	33.2	41	27	.118	.150	.157	.108
6	29.625	29.509	29.440	29.525	32	40	38	34.5	44.5	43	40.7	46	29.5	.149	.189	.164	.167
7	29.372	29.274	29.202	29.283	40	46	44	42.5	49.5	46	46.0	57.5	40	.215	.265	.262	.247
8	29.172	29.178	29.198	29.183	44	52	46	46.5	55	47	49.5	57.5	44	.255	.349	.297	.300
9	29.188	29.256	29.336	29.260	37.5	42.5	52	40	49.5	34	41.2	55	33	.192	.180	.155	.176
10	29.348	29.320	29.217	29.295	31	38.5	57	32.5	40.5	39	37.3	42	32	.157	.207	.194	.186
11	29.079	29.006	29.217	29.101	37.5	36	51.5	38.5	37.5	33	36.3	39.5	30.5	.211	.192	.159	.187
12	29.381	29.421	29.470	29.424	29.5	37.5	51.5	31.5	42	34.5	29.3	46	28.5	.140	.166	.139	.148
13	29.473	29.357	29.208	29.346	33	40	38	35.5	43.5	43	40.7	44.5	31.5	.156	.202	.164	.174
14	28.974	28.841	28.913	28.909	43.5	43.5	56.5	44.5	44.5	38.5	42.5	47.5	36	.271	.271	.190	.244
15	28.934	28.812	....	28.873	36	38	34	38.5	40.5	36.5	38.5	42.5	34	.179	.196	.163	.179
16	28.843	28.913	28.975	28.910	32	36	32	34.5	38	36	36.2	43	30.5	.149	.186	.129	.155
17	29.032	28.986	28.946	28.988	30.5	37.5	36	33	41	38.5	37 5	42	31	.141	.179	.179	.166
18	29.029	29.072	29.083	29.061	32.5	42	34.5	34.5	46.5	36.5	39.2	47	30.5	.158	.208	.174	.180
19	29.039	29.021	29.078	29.046	30.5	41	37	32	43	40	38.3	47	28.5	.153	.231	.181	.188
20	29.221	29.277	29.297	29.265	31	29	28	32.5	32	29.5	31.3	34	28.5	.157	.126	.136	.140
21	29.283	29.227	29.177	29.229	28	32	28	30	32	29	30.3	37	27.5	.130	.181	.142	.151
22	29.152	29.348	29.397	29.299	29	29	26	30.5	30	27.5	29.3	33.5	25	.143	.149	.123	.138
23	29.434	29.442	29.478	29.451	26	29	26	28	29.5	28	25.2	34	26	.117	.103	.117	.112
24	29.466	29.442	29.447	29.452	23	26	25	25.5	30	27	30.8	31	23	.095	.095	.112	.101
25	29.307	29.092	29.110	29.170	24	32	30	26.5	36.5	33.5	32.2	36.5	22.5	.109	.123	.127	.117
26	29.169	29.220	29.273	29.221	28	35	31	29.5	37.5	32	33.0	44.5	26	.136	.171	.162	.156
27	29.145	29.033	28.844	29.007	37	40	41	37.5	41	41.5	40.0	44.5	30.5	.214	.235	.251	.233
28	28.851	28.861	29.013	29.242	37.5	34.5	28.5	37.5	34.5	29.5	33.8	38.5	29.5	.220	.196	.145	.187
29	29.088	29.118	29.148	29.118	27.5	27.5	27	27.5	27.5	27.5	27.5	33	25	.150	.150	.141	.147
30	29.200	29.292	29.443	29.312	25	25	22	25.5	26	23.5	25.0	30.5	22	.129	.123	.103	.118
Means....	29.252	29.236	29.281	29.263	....	....	....	33.3	38.2	34.2	35.2	....	....	.158	.181	.159	.165
Dec. 1	29.408	29.278	29.152	29.279	18	30	25.5	18.5	30.5	28.5	25.8	34.5	17	.093	.161	.103	.119
2	29.091	29.051	29.051	29.064	27.5	38	38	30	43	41	38.0	43.5	26	.121	.164	.190	.158
3	28.912	28.796	28.797	28.835	40.5	42.5	38.5	41	43.5	39.5	41.3	44	39	.246	.259	.220	.242
4	28.906	28.971	29.134	29.004	32	36.5	31	32.5	39	32	34.5	41.5	28.5	.175	.183	.162	.173
5	29.342	29.474	29.535	29.450	28	36	29	29.5	39	30	32.8	46	26	.136	.173	.149	.153
6	29.506	....	29.168	29.337	27	....	36	27.5	....	38	32.8	41	25	.141	....	.186	.164
7	29.164	29.041	28.991	29.065	30.5	41	40	31.5	45	41	39.2	60.5	29.5	.155	.205	.235	.198
8	28.816	28.735	28.901	28.817	27	22.5	20.5	28.5	23.5	21.5	24.5	30.5	19	.130	.109	.098	.112
9	28.905	28.956	28.953	28.938	13.5	11	02.5	15	12	03	10.0	21	10	.063	.061	.043	.056
10	29.010	29.013	29.100	29.041	11	17	9	13	18.5	10	13.8	21.5	0.0	.049	.079	.054	.061
11	29.125	29.130	29.177	29.144	4	12	8.5	4	14.5	9.5	09.3	23	1.0	.052	.046	.053	.050
12	29.281	29.338	29.401	29.340	5	13	11	5.5	14.5	12	10.7	23.5	3.0	.049	.061	.061	.057
13	29.468	29.502	29.613	29.528	11.5	14.5	15	12	15.5	15.5	14.3	22	8.0	.067	.072	.080	.073
14	29.731	29.761	29.772	29.755	13.5	21	16	14.5	19	16.5	16.7	24.5	12.5	.069	....	.084	.077
15	29.747	29.672	29.581	29.667	12	17.5	13.5	12	18.5	14.5	15.0	23	....	.075	.085	.069	.076
16	29.341	29.263	29.255	29.286	21.5	23.5	19	22	24.5	20.5	22.3	31.5	13	.109	.114	.096	.103
17	29.253	29.317	29.358	29.309	26	25	23	27	27	25	26.0	34	23.5	.129	.112	.100	.114
18	29.260	29.210	29.233	29.234	23	26	26	23.5	27	27	25.8	34	22.5	.118	.129	.129	.125
19	29.488	29.630	29.758	29.625	19.5	14	12.5	20	15.5	13.5	16.3	30	10.5	.099	.065	.065	.076
20	29.890	29.688	29.534	29.704	-1	15.5	20	0.0	16.5	21	12.5	25.5	-5	.030	.076	.096	.067
21	29.366	29.226	29.128	29.240	23	29	29.5	24.5	30	30.5	28.3	31.5	19.5	.106	.149	.152	.136
22	28.876	28.692	28.707	28.758	33	37	37	34.5	37.5	37.5	36.5	43.5	19.5	.169	.214	.214	.199
23	28.692	28.715	28.767	28.725	34	33.5	27.5	35.5	35.5	28.5	33.2	44.5	26.5	.176	.192	.139	.169
24	28.823	28.918	28.973	28.905	16	13	10	16	14.5	15	15.2	26.5	9.5	.090	.061	.012	.054
25	29.087	29.095	29.126	29.103	10	18	13	10.5	19.5	14	14.7	24.5	8.5	.062	.081	.067	.070
26	29.137	29.063	29.165	29.122	12	16	9	12.5	17.5	9.5	13.2	29	8.5	.069	.073	.059	.067
27	29.282	29.388	29.480	29.383	10	12	10	10.5	13	10.5	11.3	22	7	.062	.063	.062	.062
28	29.584	29.682	29.568	29.611	10	10	8.5	10.5	10.5	8.5	09.8	21.5	7	.062	.062	.063	.062
29	29.478	29.453	29.428	29.453	3	6.5	3	3.5	7.5	3.5	48.3	12.5	1.5	.044	.047	.044	.045
30	29.357	29.293	29.308	29.319	0.5	11	8	1.0	12.5	8.5	07.3	18	-4.5	.020	.054	.057	.043
31	29.201	29.241	29.386	29.276	7	17.5	9	7	18.5	9.5	11.7	30	4.5	.059	.085	.059	.068
Means....	29.243	29.227	29.242	29.236	....	....	....	18.6	24.2	20.5	22.3	....	....	.098	.111	.103	.104

the northern and northwestern lakes at Marquette, Michigan.

VAPOR.				WIND.								Amount of cloudiness. (0=clear sky.) (10=sky entirely overcast.			Amount of evaporation, in U. S. inches and decimals.	Amount of rain or melted snow, in U. S. inches and decimals.
Humidity. Saturation = 1,000.				Direction. From whence.			Velocity, in miles, per hour.			Resultant velocity, in miles, per hour.	Resultant direction.					
7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.			7 a. m.	2 p. m.	9 p. m.		
											°					
.839	.799	.843	.827	SE	NW	W	2	12	12	7.0	N. 70 W.	10	6	10	......	.28
.831	.845	.885	.854	NW	NW	Calm	2	12	0	4.7	N. 45 W.	10	4	10	......	......
.883	.756	.757	.799	W	W	W	4	2	4	3.3	West	4	1	0	......	......
.644	.669	.694	.669	N	NW	N	4	2	4	3.3	N. 8 W.	8	8	10	......	......
.725	.669	.848	.747	S	S	S	2	4	2	2.7	South	5	0	0	......	......
.744	.641	.587	.657	SW	S	SE	35	4	35	17.8	South	1	8	5	......	......
.789	.748	.843	.793	S	E	E	4	2	4	2.7	S. 60 E.	8	0	10	......	......
.807	.805	.923	.845	W	W	W	2	12	4	6.0	West	0	0	0	......	......
.776	.510	.792	.693	W	W	W	4	12	2	6.0	West	0	0	0	......	......
.848	.822	.816	.829	Calm	E	Calm	0	2	0	0.7	East	7	8	10	......	.21
.906	.856	.848	.870	NW	NW	NW	12	12	4	9.3	N. 45 W.	10	1	0	......	.40
.791	.618	.712	.707	W	S	Calm	4	2	0	1.7	S. 67 W.	0	0	0	......	......
.750	.713	.587	.683	S	SE	SE	4	12	12	9.0	S. 39 E.	2	6	5	......	......
.919	.919	.813	.884	S	SE	SW	35	12	2	15.0	S. 10 E.	10	4	2	......	.39
.768	.779	.756	.768	W	SW	....	2	4	....	1.7	S. 56 W.	1	10	10	......	......
.744	.811	.610	.722	W	Calm	W	2	0	4	2.0	West	2	10	10	......	......
.752	.695	.768	.738	S	S	W	2	2	4	2.0	S. 45 W.	3	8	6	......	.11
.794	.657	.804	.752	W	S	W	4	2	2	2.3	S. 73 W.	0	5	4	......	......
.845	.833	.732	.803	W	Calm	NW	2	0	4	1.7	N. 56 W.	0	6	6	......	......
.848	.694	.834	.792	NW	NW	NW	25	4	12	13.7	N. 45 W.	10	8	10	......	......
.782	1.000	.887	.890	NE	E	E	12	2	12	8.0	N. 69 E.	4	6	10	......	.08
.839	.890	.824	.851	Calm	N	N	0	4	2	2.0	North	4	10	4	......	.15
.768	.524	.768	.687	NW	NW	NW	2	12	4	6.0	N. 45 W.	8	4	6	......	.10
.689	.569	.761	.673	NW	NW	NW	4	2	2	2.6	N. 45 W.	8	3	7	......	......
.699	.568	.659	.642	S	S	S	12	45	12	2.3	South	5	0	10	......	......
.834	.762	.896	.831	W	W	Calm	2	2	0	1.3	West	2	10	10	......	......
.952	.912	.956	.940	S	SE	S	2	12	4	5.7	S. 30 E.	10	10	10	......	.52
1.000	1.000	.888	.963	SW	W	NW	4	4	12	5.3	N. 70 W.	6	10	10	......	......
1.000	1.000	.941	.980	NW	NW	NW	12	12	12	12.0	N. 45 W.	10	10	10	......	.36
.938	.876	.803	.872	NW	NW	NW	4	4	2	3.3	N. 45 W.	8	4	10	......	......
.817	.765	.794	.792	....	....	....	....	....	....	2.0	S. 65 W.	5.2	5.3	6.5	......	2.60
.921	.947	.660	.843	NW	SE	S	4	12	25	10.3	S. 11 E.	0	3	0	......	......
.729	.587	.738	.685	S	S	S	4	4	25	11.0	South	0	0	10	......	......
.957	.917	.908	.927	SE	SE	W	12	12	2	7.7	S. 41 E.	10	10	10	......	.16
.945	.770	.896	.870	Calm	W	W	0	12	2	4.7	West	4	0	0	......	......
.834	.726	.890	.817	W	W	W	2	4	2	2.7	West	0	0	10	......	......
.941	......	.811	.876	Calm	....	SE	0	....	12	4.0	S. 45 E.	2	0	0	......	......
.894	.684	.912	.830	Calm	SE	W	0	12	4	3.3	S. 27 E.	0	0	10	......	......
.829	.866	.858	.851	N	N	N	25	35	2	20.7	North	10	10	0	......	.62
.734	.804	.864	.801	NW	NW	W	4	12	12	8.7	N. 64 W.	7	2	0	......	......
.623	.768	.791	.727	NW	NW	NW	12	12	4	9.3	N. 45 W.	10	0	0	......	......
1.000	.553	.787	.780	W	W	W	4	25	4	11.0	West	0	6	10	......	......
.877	.730	.804	.804	W	W	W	4	12	4	6.7	West	0	10	10	......	......
.902	.826	.913	.880	N	N	W	12	4	4	5.7	N. 14 W.	8	4	10	......	.10
.819	......	.916	.868	N	Calm	W	2	0	2	1.0	N. 45 W.	10	10	6	......	.08
1.000	.842	.819	.887	E	SE	SE	2	4	12	6.0	S. 49 E.	10	0	6	......	......
.930	.870	.780	.860	W	W	W	4	25	12	13.7	West	6	6	4	......	......
.880	.761	.746	.796	NW	NW	E	12	4	2	5.0	N. 38 E.	4	6	4	......	......
.933	.880	.880	.898	S	Calm	Calm	2	0	0	0.7	South	10	10	4	......	.09
.925	.739	.813	.826	N	N	E	25	25	12	17.3	N. 14 E.	4	3	2	......	.10
.695	.831	.855	.794	E	SE	SW	12	45	25	18.7	S. 28 E.	10	1	4	......	......
.807	.890	.891	.863	SE	SE	SE	25	12	25	20.7	S. 45 E.	6	4	3	......	......
.845	.952	.952	.916	S	SE	Calm	25	12	0	11.3	S. 14 E.	10	6	4	......	......
.849	1.000	.885	.911	W	W	NW	2	4	4	3.0	N. 72 W.	2	2	4	......	......
1.000	.730	.136	.622	N	NW	NW	2	4	4	3.0	N. 39 W.	3	10	10	......	.06
.893	.772	.816	.829	Calm	NW	Calm	0	4	0	1.3	N. 45 W.	6	2	10	......	......
.904	.757	.894	.852	NW	NW	NW	4	4	12	6.7	N. 45 W.	0	2	10	......	......
.898	.810	.898	.869	N	NW	NW	25	25	12	19.3	N. 27 W.	10	4	10	......	.28
.898	.898	1.000	.932	N	NW	NW	12	35	12	18.7	N. 36 W.	10	10	10	......	.28
.867	.773	.867	.836	NW	NW	NW	12	4	4	6.7	N. 45 W.	5	3	10	......	......
.429	.711	.890	.677	W	S	N	2	2	12	3.7	N. 11 W.	2	8	10	......	......
1.000	.842	.894	.912	W	NW	NW	2	25	12	13.0	N. 47 W.	6	3	0	......	......
.863	.801	.831	.833	....	....	....	....	....	....	2.5	N. 62 W.	5.3	4.3	5.9	......	1.77

Reductions of the monthly meteorological register of the survey of

Date.	Barometer reduced to temperature of 32° Fahr., expressed in United States inches and decimals.				TEMPERATURE—FAHRENHEIT.									VAPOR.			
					Wet bulb, or point of evaporation.			Dry bulb, or temperature of the open air.				Maximum.	Minimum.	Elasticity, in U. S. inches and decimals.			
	7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	Mean.			7 a. m.	2 p. m.	9 p. m.	Mean.
1866.					°	°	°	°	°	°	°	°	°				
July 1	29.453	29.396	29.368	29.406	56	56	58	63	59	60	60.7	66	59	.356	.409	.456	.440
2	29.406	29.355	29.305	29.355	63	68	62	66	77	67	70.0	79	61	.536	.564	.489	.530
3	29.198	29.075	29.035	29.103	61	64	61	66	77	64	69.0	78	62	.470	.422	.497	.463
4	29.100	29.080	29.124	29.101	61	67	66	68	80	73	73.7	85	60	.443	.487	.545	.492
5	29.155	29.164	29.149	29.156	67	72	72	74	84	79	79.0	91	68	.568	.623	.690	.627
6	29.264	29.209	29.206	29.226	72	76	72	80	90	79	83.0	92	72	.677	.708	.690	.692
7	29.232	29.219	29.229	29.227	67	70	67	73	79	71	74.3	84	70	.581	.612	.608	.600
8	29.383	29.460	29.523	29.455	58	56	50	68	66	55	63.0	70	55	.350	.316	.295	.320
9	29.616	29.604	29.561	29.594	50	56	51	56	62	56	58.0	68	51	.282	.369	.308	.320
10	29.614	29.546	29.521	29.565	58	62	59	64	70	66	66.7	76	52	.403	.449	.407	.420
11	29.561	29.488	29.457	29.502	62	69	65	71	85	73	76.3	89	61	.436	.594	.510	.513
12	29.502	29.434	29.414	29.453	68	74	73	77	93	82	84.0	95	67	.564	.583	.690	.612
13	29.422	29.349	29.333	29.368	74	74	73	83	94	81	86.0	97	74	.718	.569	.703	.663
14	29.341	29.226	29.339	29.302	72	72	69	82	87	77	82.0	95	74	.650	.582	.601	.611
15	29.354	29.361	29.343	29.353	71	74	73	81	94	82	85.7	95	72	.624	.569	.690	.628
16	29.419	29.381	29.371	29.390	74	74	73	84	93	82	86.3	97	81	.704	.583	.690	.649
17	29.429	29.364	29.349	29.381	72	68	62	82	78	65	75.0	87	65	.650	.550	.516	.572
18	29.373	29.388	29.391	29.384	56	60	55	61	68	63	64.0	72	50	.383	.411	.327	.374
19	29.456	29.431	29.403	29.430	56	58	59	63	72	62	65.7	74	57	.356	.296	.460	.367
20	29.396	29.373	29.333	29.367	62	63	62	67	71	67	68.3	76	56	.489	.469	.489	.482
21	29.253	29.160	29.180	29.198	65	67	65	69	74	68	70.3	75	65	.564	.568	.577	.570
22	29.243	29.228	29.218	29.230	65	66	67	70	73	71	71.3	81	63	.550	.545	.608	.568
23	29.286	29.303	29.308	29.299	57	59	58	60	64	61	61.7	72	60	.426	.433	.443	.434
24	29.343	29.327	29.360	29.343	61	65	64	68	74	69	70.3	77	59	.443	.497	.529	.490
25	29.423	29.428	29.432	29.428	65	76	66	71	79	72	74.0	84	63	.537	.856	.559	.651
26	29.418	29.375	29.345	29.379	66	72	70	72	77	73	74.0	79	67	.559	.718	.693	.657
27	29.358	29.362	29.342	29.350	64	72	67	68	78	70	72.0	80	66	.543	.704	.622	.623
28	29.338	29.312	29.302	29.317	68	69	63	70	79	70	73.0	81	66	.658	.574	.482	.571
29	29.298	29.217	29.260	29.258	64	67	63	73	80	69	74.0	82	65	.476	.487	.495	.486
30	29.353	29.358	29.353	29.355	64	64	63	67	76	68	70.3	78	65	.556	.436	.509	.500
31	29.323	29.167	29,097	29.196	63	71	68	69	87	74	76.7	90	64	.495	.543	.704	.584
Means....	29.365	29.327	29.391	29.338	....	....	....	70.5	78.1	69.9	73.0	....	....	.518	.533	.545	.532
August 1	29.175	29.158	29.225	29.186	62	61	59	69	79	70	72.7	90	64	.462	.296	.354	.371
2	29.391	29.415	29.413	29.406	55	61	59	61	75	67	67.7	77	55	.354	.350	.393	.366
3	29.398	29.293	29.268	29.320	58	65	58	66	76	62	68.0	78	62	.376	.470	.429	.425
4	29.248	29.556	29.566	29.457	54	56	53	60	67	59	62.0	70	55	.338	.631	.356	.442
5	29.621	29.583	29.576	29.593	54	68	56	61	72	63	65.3	74	53	.407	.363	.356	.375
6	29.593	29.521	29.521	29.545	59	58	58	66	67	63	65.3	74	52	.407	.363	.416	.395
7	29.413	29.376	29.346	29.378	58	61	61	62	65	63	63.3	66	51	.429	.483	.510	.474
8	29.156	29.050	29.271	29.159	62	65	55	64	71	60	65.0	75	60	.529	.537	.367	.478
9	29.341	29.323	29.348	29.337	57	62	62	61	79	67	69.0	80	53	.412	.329	.489	.410
10	29.401	29.415	29.405	29.407	61	64	62	67	72	68	69.0	74	62	.457	.489	.476	.474
11	29.430	29.351	29.281	29.354	63	62	65	66	65	68	66.3	68	62	.536	.516	.577	.543
12	29.181	29.170	29.197	29.183	65	74	68	68	84	72	74.7	85	65	.577	.704	.631	.637
13	29.260	29.303	29.325	29.296	65	62	60	69	68	62	66.3	74	63	.564	.476	.491	.510
14	29.321	29.360	29.453	29.378	63	68	60	67	77	67	70.3	82	60	.522	.564	.425	.504
15	29.623	29.637	29.661	29.640	57	54	50	63	63	54	60.0	68	54	.386	.298	.308	.331
16	29.596	29.654	29.589	29.613	56	57	52	62	65	55	60.7	67	50	.369	.359	.349	.359
17	29.569	29.511	29.473	29.518	53	61	59	57	72	62	63.7	75	48	.350	.390	.460	.400
18	29.496	29.376	29.331	29.401	59	60	58	65	62	61	62.7	70	61	.420	.491	.443	.451
19	29.344	29.356	29.351	29.350	57	56	53	60	65	56	60.3	67	54	.426	.330	.363	.373
20	29.232	29.241	29.253	29.242	53	57	54	57	72	60	63.0	75	52	.350	.386	.338	.358
21	20.271	29.231	29.277	29.260	54	54	52	57	68	56	60.3	70	51	.378	.232	.335	.315
22	29.344	29.312	29.277	29.311	46	51	49	49	62	55	55.3	65	46	.271	.229	.269	.256
23	29.340	29.337	29.352	29.343	45	52	48	49	60	51	53.3	61	48	.247	.282	.296	.275
24	29.397	29.380	29.407	29.395	45	50	49	49	60	53	54.0	62	47	.247	.229	.295	.257
25	29.447	29.367	29.329	29.381	47	55	51	50	69	56	58.3	71	46	.283	.247	.308	.279
26	29.249	29.198	29.186	29.211	51	62	59	58	75	66	66.3	76	54	.282	.382	.407	.357
27	29.206	29.203	29.216	29.208	57	62	59	63	71	61	65.0	75	62	.386	.436	.473	.432
28	29.256	29.311	29.321	29.296	56	55	54	60	63	57	60.0	65	58	.396	.327	.378	.367
29	29.346	29.318	29.278	29.314	55	65	59	58	68	63	63.0	72	52	.393	.577	.447	.472
30	29.208	29.180	29.166	29.185	60	63	61	65	65	63	64.3	66	60	.451	.549	.510	.503
31	29.110	29.017	29.032	29.053	62	65	66	65	70	68	67.7	74	63	.516	.550	.612	.559
Means ...	29.365	29.350	29.356	29.357	....	....	....	63.1	71.6	63.6	66.1	....	....	.404	.415	.415	.411

the northern and northwestern lakes at Milwaukee, Wisconsin.

VAPOR.				WIND.								Amount of cloudiness. (0 = clear sky.) (10 = sky entirely overcast.)			Amount of evaporation, in U. S. inches and decimals.	Amount of rain or melted snow, in U. S. inches and decimals.
Humidity. Saturation = 1,000.				Direction. From whence.			Velocity, in miles, per hour.			Resultant velocity, in miles, per hour.	Resultant direction.					
7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.			7 a. m.	2 p. m.	9 p. m.		
											°					
.619	.819	.880	.773	SW. . .	S.SE.	Calm . .	0.6	0.2	0	0.2	S. 5 W. .	10	10	10	......	.36
.838	.608	.740	.729	W.SW.	S.SW	W.SW.	0.5	1.5	1.3	1.0	S. 51 W.	10	7	10	......	.01
.735	.456	.833	.675	W.SW.	W.SW.	Calm . .	1.0	2.8	0	1.3	S. 71 W.	8	6	2	......	.21
.647	.476	.672	.598	W.NW	W.	Calm . .	0.5	1.8	0	0.7	N. 79 W.	0	0	0	......	......
.677	.535	.697	.636	W.SW.	S.SE . .	SW. . .	1.1	2.9	0.4	1.0	S. 9 W. .	5	7	5	......	......
.661	.503	.697	.620	W.SW.	SW. . .	W.SW.	1.0	2.5	0.2	1.0	S. 49 W.	0	5	1	......	.02
.716	.618	.802	.712	W.	W.SW.	Calm . .	0.6	0.3	0	0.3	S. 58 W.	9	10	1	......	......
.511	.495	.681	.582	NE . . .	E.NE. .	Calm . .	1.7	1.0	0	1.0	N. 51 E.	1	2	3	......	......
.627	.665	.687	.660	NE . . .	E.NE. .	Calm . .	2.5	0.8	0	1.0	N. 49 E.	0	0	0	......	......
.675	.613	.636	.641	Calm . .	S.SE . .	Calm . .	0	1.8	0	0.7	S. 15 E.	0	2	0	......	......
.576	.410	.629	.538	W.	S.	SW. . .	0.6	0.9	0.2	0.6	S. 19 W.	0	0	0	......	......
.608	.377	.632	.539	W.SW.	W.NW	Calm . .	0.6	1.5	0	0.6	N. 62 W.	0	1	0	......	......
.636	.357	.665	.553	W.NW	W.	Calm . .	0.5	1.3	0	0.6	N. 77 W.	0	1	1	......	......
.595	.454	.648	.566	W.NW	S.	Calm . .	1.0	0.6	0	0.3	S. 67 W.	1	1	0	......	......
.590	.357	.632	.526	W.SW.	W.NW	SW. . .	0.5	3.0	0.2	1.3	N. 79 W.	0	1	0	......	......
.605	.377	.632	.538	W.NW	W.NW	W.NW	1.2	2.7	0.2	1.3	N. 69 W.	0	9	3	......	......
.595	.574	.836	.668	W.NW	SE	E.NE. .	1.8	1.3	1.3	0.2	N. 71 E.	4	1	10	......	.89
.713	.601	.568	.627	N.NE. .	NE . . .	N.	1.6	3.2	0.6	1.7	N. 33 E.	10	3	1	......	......
.619	.378	.828	.608	NE . . .	E.NE. .	Calm . .	0.2	0.5	0	0.2	N. 71 E.	5	0	2	......	......
.740	.618	.740	.699	NE . . .	SE.	Calm . .	0.5	0.5	0	0.2	East. . . .	0	2	3	......	......
.796	.677	.843	.772	Calm . .	SE	Calm . .	0	2.3	0	0.6	S. 45 E	0	5	0	......	.51
.751	.672	.802	.742	Calm . .	S.SE . .	Calm . .	0	0.5	0	0.2	S. 19 E. .	0	8	9	......	......
.822	.727	.825	.791	NE . . .	NE . . .	NE . . .	3.0	3.8	0.4	2.3	N. 45 E.	10	5	8	......	......
.647	.593	.747	.662	NE . . .	E.SE . .	Calm . .	0.7	0.4	0	0.3	N. 71 E.	0	0	1	......	......
.708	.865	.712	.762	Calm . .	S.SE . .	Calm . .	0	1.3	0	0.7	S. 15 E.	8	2	1	......	......
.712	.774	.854	.780	Calm . .	S.	S.SE . .	0	0.8	0.5	0.3	S. 13 E.	9	10	10	......	.65
.793	.734	.848	.792	NE . . .	E.NE. .	Calm . .	0.2	0.6	0	0.2	N. 71 E.	10	9	0	......	......
.898	.580	.658	.712	Calm . .	E.NE. .	Calm . .	0	0.2	0	0.0	East. . . .	8	1	0	......	......
.588	.476	.700	.588	NE . . .	S.SE . .	N.NW.	0.6	1.6	0.5	0.3	S. 59 E.	0	2	0	......	......
.841	.486	.743	.690	NE . . .	E.NE. .	Calm . .	2.8	1.0	0	1.2	N. 47 E.	1	0	1	......	......
.700	.424	.720	.615	W.SW.	SW. . .	N.NW.	0.8	3.5	1.5	1.3	S. 55 W.	8	2	3	......	.08
.685	.558	.729	.657	....	....	....	....	....	....	0.5	S. 83 W.	3.8	3.6	2.7	......	2.73
.653	.300	.482	.478	NW. . .	W.NW	NW. . .	2.5	3.6	1.0	2.3	N. 58 W.	0	0	0	......	......
.659	.403	.595	.552	N.NW.	S.SE . .	Calm . .	1.3	1.4	0	.....	....	0	2	1	......	......
.588	.524	.772	.628	W.NW	SW. . .	N.NE. .	1.5	1.0	1.0	0.7	N. 69 W.	8	8	2	......	.15
.653	.804	.619	.692	N.NE. .	NE . . .	Calm . .	0.7	3.9	0	1.3	N. 37 E.	0	0	1	......	......
.636	.550	.619	.602	Calm . .	S.SE . .	Calm . .	0	1.2	0	0.7	S. 13 E.	1	2	2	......	......
.636	.550	.723	.636	Calm . .	W.NW	Calm . .	0	0.8	0	0.3	N. 71 W.	9	10	10	......	......
.772	.783	.886	.780	S.SE . .	SE	E.SE . .	3.0	1.5	0.7	1.3	S. 28 E.	10	10	10	......	.38
.888	.708	.708	.768	S.SE . .	NW. . .	N.NE. .	1.1	3.1	1.9	1.0	N. 17 W.	10	10	5	......	.43
.769	.332	.740	.614	NW. . .	N.NW.	Calm . .	2.5	1.6	0	1.3	N. 36 W.	0	0	1	......	......
.690	.624	.695	.670	Calm . .	SE . . .	Calm . .	0	0.2	0	0.2	S. 45 W.	3	9	5	......	......
.838	.836	.843	.839	S.SE . .	S.SE . .	S.	0.4	1.5	1.3	1.0	S. 17 E.	10	10	10	......	.88
.843	.605	.804	.751	Calm . .	W.NW	Calm . .	0	0.8	0	0.3	N. 67 W.	10	5	0	......	.25
.796	.695	.884	.792	Calm . .	NE . . .	Calm . .	0	2.5	0	0.7	N. 45 E.	10	8	0	......	......
.790	.608	.642	.680	W.NW	E.	NE . . .	0.9	0.5	2.1	0.7	N. 33 E.	0	5	0	......	......
.670	.519	.738	.642	NE . . .	NE . . .	N.NE. .	4.0	4.2	0.8	3.0	N. 32 E.	1	0	0	......	......
.665	.582	.805	.684	S.SE . .	SE	Calm . .	1.4	0.8	0	0.7	S. 31 E	2	0	0	......	......
.752	.497	.828	.692	NW. . .	S.SE . .	Calm . .	0.4	2.1	0	0.7	S. 18 E.	0	1	0	......	......
.680	.884	.825	.796	W.NW	NE . . .	Calm . .	0.7	1.5	0	0.7	N. 13 E.	10	10	10	......	.44
.822	.535	.809	.722	N.NE. .	E.NE. .	Calm . .	1.3	2.0	0	1.0	N. 51 E.	9	1	0	......	......
.752	.670	.653	.692	N.NW.	NW. . .	N.NE. .	1.0	2.9	0.2	1.3	N. 46 W.	2	10	1	......	.08
.812	.340	.747	.633	Calm . .	NW. . .	N.NE. .	0	2.0	0.6	0.7	N. 38 W.	0	3	5	......	......
.781	.412	.620	.604	N.NW.	S.SE . .	N.NW.	0.5	1.1	0.3	0.2	S. 44 E.	0	7	3	......	......
.710	.546	.790	.682	N.NE. .	N.NW.	Calm . .	1.2	0.7	0	0.7	N. 13 E.	5	10	10	......	.34
.710	.442	.733	.628	NW. . .	NW. . .	Calm . .	0.2	0.7	0	0.3	N. 45 W.	1	8	1	......	......
.786	.350	.687	.608	Calm . .	W.NW	Calm . .	0	0.8	0	0.2	N. 69 W.	10	3	0	......	......
.584	.441	.636	.554	W.	W.SW.	W.SW.	1.8	1.7	0.5	1.3	S. 80 W.	0	7	8	......	......
.670	.576	.882	.709	W.NW	....	E.NE. .	0.7	....	1,0	0.2	N. 21 E.	10	8	10	......	.26
.765	.568	.812	.715	NE . . .	E.NE. .	Calm . .	1.0	1.0	0	0.7	N. 61 E	10	1	2	......	......
.816	.843	.776	.812	Calm . .	W.NW	Calm . .	0	0.4	0	0.2	N. 57 W.	0	10	9	......	.15
.731	.890	.886	.836	Calm . .	S.SE . .	E.NE. .	0	0.2	0.2	0.2	S. 45 E.	10	10	10	......	.29
.836	.751	.895	.827	Calm . .	S.SE . .	S.SW .	0	1.2	0.5	0.6	S. 13 E.	10	9	10	......	.30
.734	.586	.749	.689	....	....	....	....	....	....	0.2	N. 1 E. .	4.9	5.7	4.1	......	3.95

Reductions of the monthly meteorological register of the survey of

Date.	Barometer reduced to temperature of 32° Fahr., expressed in United States inches and decimals.				Temperature—Fahrenheit.									Vapor.			
					Wet bulb, or point of evaporation.			Dry bulb, or temperature of the open air.				Minimum.	Maximum.	Elasticity, in U. S. inches and decimals.			
	7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	Mean.			7 a. m.	2 p. m.	9 p. m.	Mean.
1866.					°	°	°	°	°	°	°	°	°				
Sept. 1	29.010	29.036	29.027	29.024	65	67	65	68	70	68	68.7	74	63	.577	.622	.577	.592
2	29.186	29.323	29.323	29.277	55	60	59	60	71	65	65.3	73	57	.367	.371	.420	.386
3	29.358	29.366	29.373	29.332	51	63	62	54	70	65	63.0	74	54	.335	.482	.516	.444
4	29.183	29.100	29.236	29.173	63	67	54	66	73	60	66.3	76	60	.536	.581	.338	.485
5	29.364	29.341	29.381	29.362	51	56	54	54	71	59	61.3	73	51	.335	.250	.351	.312
6	29.419	29.421	29.396	29.412	54	58	54	60	66	58	61.3	68	56	.338	.376	.365	.360
7	29.316	29.334	29.244	29.265	55	59	54	58	66	59	61.0	70	56	.393	.407	.351	.384
8	29.319	29.409	29.536	29.421	49	54	52	52	66	55	57.7	67	51	.308	.259	.349	.305
9	29.602	29.601	29.566	29.590	48	58	55	51	64	59	58.0	68	48	.296	.403	.380	.360
10	29.436	29.304	29.186	29.309	61	59	59	63	62	61	62.0	67	59	.510	.460	.473	.481
11	29.013	28.925	28.966	28.968	61	63	60	62	67	63	64.0	70	61	.523	.522	.478	.508
12	29.023	29.075	29.206	29.101	53	53	48	58	64	55	59.0	70	56	.336	.257	.243	.279
13	29.332	29.312	29.302	29.315	48	55	52	52	64	55	57.0	65	50	.282	.314	.349	.315
14	29.314	29.442	29.542	29.433	47	45	42	52	57	45	51.3	59	45	.257	.273	.228	.253
15	29.597	29.345	29.490	29.477	40	50	49	42	57	53	50.7	60	49	.221	.268	.295	.261
16	29.277	29.218	29.336	29.277	53	61	51	57	65	56	59.3	66	54	.350	.483	.308	.380
17	29.482	29.455	29.403	29.446	41	48	45	45	55	50	50.0	56	44	.205	.243	.234	.230
18	29.340	29.287	29.315	29 314	41	46	46	47	49	51	49.0	55	46	.179	.271	.245	.232
19	29.407	29.430	29.460	29.432	46	43	42	52	52	52	52.0	56	49	.232	.160	.136	.176
20	29.438	29.381	29.433	29.417	40	39	39	44	43	44	43.7	53	42	.195	.186	.173	.185
21	29.481	29.471	29.495	29.482	34	45	38	38	52	41	43.7	54	36	.144	.207	.190	.180
22	29.403	29.443	29.382	29.409	37	46	47	40	55	55	50.0	57	36	.181	.192	.217	.197
23	29.382	29.287	29.274	29.314	48	50	54	53	58	57	56.0	60	52	.269	.255	.378	.301
24	29.046	29.213	29.399	29.219	57	54	50	61	63	54	59.3	67	55	.412	.288	.308	.336
25	29.457	29.470	29.535	29.487	48	49	41	54	56	44	51.3	57	44	.256	.255	.218	.243
26	29.567	29.467	29.467	29.500	43	54	50	45	66	55	55.3	67	41	.251	.259	.295	.268
27	29.537	29.502	29.496	29.512	48	59	53	52	67	57	58.7	71	50	.282	.393	.350	.342
28	29.559	29.504	29.516	29.526	48	59	52	53	71	57	60.3	73	49	.269	.340	.322	.310
29	29.559	29.544	29.568	29.557	50	60	55	53	70	60	61.0	74	50	.321	.385	.367	.358
30	29.639	29.584	29.566	29.596	49	55	51	53	61	53	59.0	63	53	.295	.354	.348	.332
Means....	29.368	29.349	29.375	29.364	....	....	...	54.6	62.3	55.5	57.5	....	....	.315	.337	.327	.326
Oct. 1	29.537	29.486	29.366	29.463	50	63	58	53	77	64	64.7	78	50	.381	.522	.403	.415
2	29.298	29.402	29.510	29.403	54	50	46	58	56	51	55.0	65	51	.365	.282	.245	.297
3	29.535	29.442	29.512	29.496	44	48	45	49	55	48	50.7	57	48	.223	.243	.260	.242
4	29.597	29.635	29.700	29.644	47	48	46	51	54	52	52.3	56	43	.270	.256	.232	.253
5	29.767	29.715	29.707	20.730	46	50	47	52	57	50	53.0	58	50	.232	.268	.283	.261
6	29.662	29.547	29.552	29.587	43	59	56	46	66	60	57.3	67	45	.238	.457	.396	.347
7	29.559	29.591	29.573	29.574	53	62	58	55	73	62	63.3	74	55	.376	.409	.429	.405
8	29.351	29.268	29.261	29.293	56	58	48	60	63	55	59.3	68	55	.396	.416	.243	[illegible]
9	29.237	20.206	29.300	20.248	48	55	45	53	58	49	53.3	62	49	.269	.393	.247	.303
10	29 385	29.447	29.527	29.453	47	54	48	50	63	51	54.7	64	49	.283	.298	.296	[illegible]
11	29.540	29.482	29.442	29.488	46	47	46	49	53	48	50.0	55	48	.271	.244	.284	[illegible]
12	29.450	29.405	29.422	29.426	47	52	51	50	58	54	54.0	60	46	.283	.309	.335	[illegible]
13	29.507	29.517	29.557	29.527	51	52	48	48	58	51	52.3	59	51	.292	.309	.296	[illegible]
14	29.670	29.700	29.780	29.717	42	53	51	44	58	53	51.7	60	43	.241	.336	.348	.308
15	29.875	29.885	29.895	29.885	46	53	44	48	60	46	51.3	61	46	.284	.310	.262	[illegible]
16	29.891	29.797	29.717	29.802	41	53	45	43	62	48	51.0	66	42	.231	.284	.260	[illegible]
17	29.615	29.477	29.417	29.503	43	55	48	47	65	53	55.0	70	43	.225	.300	.269	[illegible]
18	29.302	29.161	29.199	29.221	55	56	56	58	71	60	63.0	72	47	.393	.383	.396	.391
19	29.349	29.359	29.392	29.367	48	53	48	51	59	50	53.3	62	50	.296	.323	.309	[illegible]
20	29.364	29.267	29.183	29.271	54	58	58	56	61	62	59.7	66	47	.391	.443	.429	[illegible]
21	28.966	28.875	28.687	28.843	57	59	55	60	62	58	60.0	64	58	.426	.460	.393	[illegible]
22	28.981	29.114	29.195	29.097	36	39	35	41	49	43	44.3	60	41	.147	.108	.100	.118
23	29.144	29.283	29.448	29.292	34	32	29	37	36	33	35.3	45	33	.157	.129	.114	[illegible]
24	29.536	29.496	29.475	29.502	27	33	32	30	40	37	35.7	43	30	.113	.097	.116	[illegible]
25	29.436	29.293	29.222	29.317	32	36	37	34	39	40	37.7	42	30	.155	.173	.181	.170
26	29.204	29.276	29.400	29.293	35	35	32	38	40	36	38.0	44	36	.166	.130	.129	[illegible]
27	29.521	29.431	29.358	29.437	32	37	42	35	39	45	39.7	45	35	.142	.194	.228	[illegible]
28	29.074	29.059	29.214	29.116	44	48	36	48	55	40	47.7	57	40	.236	.243	.160	[illegible]
29	29 268	29.229	29.199	29.232	35	38	35	39	44	38	40.3	46	36	.152	.151	.165	[illegible]
30	29.261	29.351	29.522	29.378	31	34	28	35	40	32	36.0	46	33	.120	.118	.096	.114
31	29.616	29.513	29.420	29.516	23	38	33	27	39	39	35.0	40	27	.078	.090	.110	[illegible]
Means....	29.435	29.410	29.425	29.423	....	....	....	46.6	54.8	48.7	50.1	....	....	.251	.278	.258	[illegible]

the northern and northwestern lakes, at Milwaukee, Wisconsin.

VAPOR.				WIND.								Amount of cloudiness. (0 = clear sky.) (10 = sky entirely overcast.)			Amount of evaporation in U. S. inches and decimals.	Amount of rain or melted snow, in U. S. inches and decimals.
Humidity. Saturation = 1,000.				Direction. From whence.			Velocity, in miles, per hour.			Resultant velocity, in miles per hour.	Resultant direction.					
7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.			7 a. m.	2 p. m.	9 p. m.		
.843	.848	.843	.845	Calm ..	S.SW .	NW ...	0	0.5	0.3	0.2	S. 65 W.	5	10	7	......	1.34
.708	.490	.680	.626	NW....	W. NW	W. NW	0.5	1.5	0.2	1.0	N. 75 W.	0	1	5	......	......
.802	.658	.836	.765	Calm ..	S. SE..	Calm ..	0	1.0	0	0.3	S. 23 E	0	0	0	......	......
.838	.716	.653	.736	S. SE..	W. NW	Calm ..	1.5	1.7	0	0.2	S. 19 W.	10	2	0	......	1.48
.802	.330	.703	.612	W	N. NW.	Calm ..	0.5	2.8	0	1.2	N. 75 W.	0	3	0	......	......
.653	.588	.756	.666	NW ...	Calm ..	Calm ..	0.2	0	0	0.1	N. 45 W.	5	10	9	......	......
.816	.636	.703	.718	Calm ..	S. SE..	Calm ..	0	0.4	0	0.1	S. 19 E	9	6	0	......	......
.794	.405	.805	.668	W. NW	N.NW.	Calm ..	1.1	1.4	0	0.7	N. 39 W.	0	1	0	......	......
.790	.675	.761	.742	Calm ..	E	Calm ..	0	1.4	0	0.5	East....	1	3	10	......	......
.886	.828	.882	.865	SE	SE	SE	0.5	1.0	0.6	0.7	S. 45 E	10	10	10	......	.56
.942	.790	.831	.854	Calm ..	Calm ..	Calm ..	0	0	0	0.0	Calm ..	10	9	10	......	.34
.698	.432	.561	.564	W. NW	W. NW	W. NW	1.7	4.5	0.2	2.0	N. 67 W.	0	0	0	......	......
.727	.527	.805	.686	Calm ..	W.SW.	NE	0	1.3	0.4	0.6	S. 73 W.	10	1	0	......	.16
.660	.847	.762	.756	NW....	NW....	Calm ..	1.7	2.2	0	1.2	N. 45 W.	0	2	0	......	......
.829	.577	.733	.713	Calm ..	S	S	0	2.1	1.4	1.2	South ..	0	10	10	......	......
.752	.783	.687	.707	S. SW.	Calm ..	N......	0.9	0	0.8	0.1	West ...	10	10	10	......	......
.684	.561	.646	.630	N. NE.	Calm ..	Calm ..	0.3	0	0	0.1	N. 19 E.	8	10	10	......	......
.554	.781	.563	.633	NE....	NE....	NE....	1.2	1.0	0.8	1.0	N. 45 E.	10	10	10	......	......
.598	.411	.350	.453	E. NE.	NE ...	E	1.2	3.2	2.6	2.0	N. 65 E.	10	10	10	......	......
.677	.669	.597	.648	E. NE.	N.NE..	N	1.5	3.0	0.5	1.3	N. 33 E.	10	10	10	......	......
.628	.535	.738	.634	Calm ..	Calm ..	Calm ..	0	0	0	0.0	Calm ...	0	3	0	......	......
.732	.445	.502	.560	Calm ..	S. SE..	S. SE..	0	2.0	2.3	1.3	S. 22 E.	0	2	8	......	......
.667	.529	.812	.669	S	S. SE..	S. SE..	0.7	1.6	0.2	1.0	S. 11 E	9	5	9	......	......
.769	.519	.738	.675	SW ...	W.NW	Calm ..	2.5	3.0	0	1.7	S. 81 W.	10	5	5	......	......
.613	.569	.756	.646	E NE .	NE....	Calm ..	0.7	0.5	0	0.3	N. 63 E	10	9	0	......	......
.840	.405	.681	.642	W.SW.	W.SW.	W.SW.	0.3	1.5	0.2	0.6	S. 71 W.	0	0	0	......	......
.727	.595	.751	.691	Calm ..	Calm ..	Calm ..	0	0	0	0.0	Calm ..	0	0	0	......	......
.667	.449	.692	.6 3	SW ...	SW ...	Calm ..	0.7	1.0	0	0.6	S. 45 W.	0	0	0	......	.....
.798	.525	.708	.677	Calm ..	S. SE..	Calm ..	0	0.3	0	0.2	S. 19 E.	0	0	0	......	......
.733	.659	.964	.732	NE ...	Calm ..	Calm ..	0.7	0	0	0.3	N. 45 E.	0	0	0	......	......
.741	.593	.713	.682	....	....	....	....	....	....	0.1	N. 77 W.	4.6	4.7	4.8	......	3.88

.798	.790	.675	.754	Calm ..	W.SW.	Calm ..	0	0.4	0	0.2	S. 71 W.	0	0	0	......	......
.756	.627	.653	.679	Calm ..	NE....	NE....	0	3.5	1.0	3.4	N. 45 E.	0	9	0	......	......
.638	.561	.777	.659	E. SE .	S. SE..	Calm ..	0.2	0.5	0	0.2	S. 21 E.	1	3	0	......	......
.722	.613	.598	.644	Calm ..	E	SE	0	0.8	0.2	0.3	S. 71 E.	3	10	0	......	......
.598	.577	.786	.654	S. SE..	S. SE..	Calm ..	0.4	1.2	0	0.7	S. 15 E.	5	0	0	......	......
.767	.636	.765	.723	Calm ..	Calm ..	Calm ..	0	0	0	0.0	Calm	0	0	0	......	......
.869	.504	.772	.715	Calm ..	W.SW.	Calm ..	0	19	0	0.7	S. 73 W.	8	1	0	......	......
.765	.723	.561	.683	SW ...	W.NW	Calm ..	0.2	0.2	0	0 1	S. 71 W.	9	10	0	......	......
.667	.816	.710	.731	Calm ..	E. SE .	Calm ..	0	1.4	0	0.2	S. 19 E	10	10	0	......	......
.786	.519	.790	.698	NE	NE	N.NW.	0.9	3.6	0.5	2.0	N. 43 E.	0	5	0	......	.10
.781	.606	.850	.746	N. NE .	NE	Calm ..	0.7	1.4	0	0.7	N. 41 E.	10	9	5	......	......
.786	.641	.802	.746	N. NE .	E. SE .	E	0.5	0.7	0.5	0.2	N. 73 E	10	8	10	......	......
.584	.641	.790	.672	S. SE..	SE	Calm ..	0.2	0.2	0	0.1	S. 19 E.	10	10	0	......	......
.836	.698	.864	.799	Calm ..	E. SE .	E.NE..	0	1.0	2.0	0.7	N. 79 E.	0	0	10	......	......
.850	.599	.843	.764	Calm ..	E	Calm ..	0	1.0	0	0.3	East....	0	0	0	......	......
.833	.511	.777	.707	Calm ..	S. SE..	Calm ..	0	0.8	0	0.3	S. 19 E.	0	2	0	......	......
..698	.487	.667	.617	Calm ..	S. SE..	Calm ..	0	1.1	0	0.3	S. 17 E.	0	0	0	......	......
.816	.713	.765	.765	SW ...	SW ...	W.NW	0.5	3.7	2.5	2.3	S. 64 E.	2	5	10	......	......
.790	.647	.856	.764	Calm ..	S. SE..	Calm ..	0	1.3	0	0.6	S. 15 E	9	0	0	......	0.7
.872	.825	.772	.823	S. SE..	S. SW.	SW ...	1.5	1.5	1.4	1.3	S. 13 W.	10	10	9	......	......
.822	.828	.816	.822	SW ...	S. SW.	S.SW .	1.4	1.5	1.4	1 7	S. 40 W.	10	10	10	......	.88
.567	.307	.357	.407	W. NW	W.NW	W. NW	4.0	6.1	4.0	4.7	N. 69 W.	0	1	0	......	.45
.712	.610	.606	.643	W. NW	W.NW	N.NW.	2.8	3.1	1.3	2.3	N. 58 W.	10	7	0	......	......
.675	.393	.527	.532	N.NW.	NW...	Calm ..	0.2	0.5	0	0.3	N. 33 W.	0	9	0	......	.02
.792	.726	.732	.747	Calm ..	S	S. SW.	0	2.0	1.2	1.0	S. 8 W	10	10	10	......	......
.719	.557	.610	.662	NW....	W.NW	W.NW	2.2	3.8	1.0	2.3	N. 58 W.	10	9	8	......	.54
.698	.816	.762	.757	Calm ..	S.SE ..	S. SE..	0	2.2	2.7	1.7	S. 21 E	9	10	10	......	......
.704	.561	.645	.637	S. SW.	W. NW	Calm ..	0.5	1.8	0	0.3	N. 77 W.	10	5	0	......	.70
.636	.522	.719	.627	N.NW.	W. NW	Calm ..	1.0	1.3	0	0.7	N. 47 W.	10	0	0	......	......
.628	.476	.510	.538	NW....	N.NW.	N. NW.	2.6	1.7	0.8	1.7	N. 33 W.	10	10	0	......	......
.529	.379	.463	.457	Calm ..	W.SW.	W. SW	0	1.5	1.1	1.0	S. 75 W.	0	5	10	......	......
.732	.610	.704	.682	....	....	....	....	....	....	0.3	N. 85 W.	5.3	5.4	3.0	......	2.76

Reductions of the monthly meteorological register of the survey of

Date.	Barometer reduced to temperature of 32° Fahr., expressed in United States inches and decimals.				TEMPERATURE—FAHRENHEIT.									VAPOR.			
					Wet bulb, or point of evaporation.			Dry bulb, or temperature of the open air.				Maximum.	Minimum.	Elasticity, in U. S. inches and decimals.			
	7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	Mean.			7 a. m.	2 p. m.	9 p. m.	Mean.
1866.					°	°	°	°	°	°	°	°	°				
Nov. 1	29.156	28.986	29.275	29.139	34	47	45	39	57	47	47.7	59	38	.131	.191	.273	.198
2	29.511	29.583	29.658	29.584	30	37	31	34	44	34	37.3	48	34	.121	.129	.139	.130
3	29.659	29.648	29.713	29.673	34	40	41	37	47	43	42.3	48	33	.157	.156	.231	.181
4	29.821	29.897	29.955	29.891	36	34	32	40	39	38	39.0	45	38	.160	.131	.103	.131
5	30.040	30.027	29.973	30.013	35	36	36	40	41	40	40.3	53	38	.139	.147	.160	.149
6	29.890	29.752	29.675	29.772	29	40	35	32	46	38	38.7	53	31	.126	.169	.165	.153
7	29.575	29.440	29.357	29.457	31	45	44	35	52	52	46.3	56	36	.128	.207	.183	.173
8	29.365	29.372	29.417	29.385	48	48	40	52	59	45	52.0	60	44	.282	.190	.182	.218
9	29.480	29.485	29.505	29.490	38	45	37	43	58	45	48.7	59	43	.164	.260	.116	.180
10	29.420	29.265	29.179	29.288	33	43	40	37	47	42	42.0	50	36	.136	.225	.221	.194
11	29.144	29,261	29.400	29.268	34	36	35	37	40	40	39.0	45	36	.157	.160	.139	.152
12	29.537	29.573	29.593	29.568	29	38	35	31	42	37	36.7	45	32	.137	.177	.178	164
13	29.420	29.347	29.225	29.331	39	40	42	43	45	47	45.0	48	34	.186	.188	.202	.190
14	29.063	29.133	29.290	29.162	44	37	38	47	43	42	44.0	49	34	.238	.142	.177	.186
15	29.123	28.969	28.898	28.997	33	35	32	37	39	35	37.0	49	35	.136	.152	.142	.143
16	28.904	28.989	29.154	29.016	30	34	34	33	40	38	37.0	41	32	.132	.118	.144	.131
17	29.211	29.154	29.136	29.167	30	39	42	32	45	45	40.7	47	32	.144	.160	.228	.177
18	29.202	29.179	29.148	29.176	34	41	41	37	45	44	42.0	49	37	.157	.205	.218	.193
19	29.083	29.036	29.086	29.068	35	40	39	38	44	42	42.0	46	38	.165	.195	.173	.178
20	29.235	29.291	29.378	29.301	34	36	35	38	42	38	39.3	46	38	.144	.134	.165	.148
21	29.373	29.118	29.074	29.188	31	34	34	34	36	37	35.7	42	34	.139	.170	.157	.189
22	29.114	....	29.424	29.269	31	....	28	33	....	31	32.0	41	31	.151	....	.119	.135
23	29.463	29.491	29.459	29.471	26	29	25	30	32	29	30.3	40	29	.095	.126	.089	.103
24	29.606	29.562	29.564	29.577	20	24	24	22	29	27	26.0	31	22	.085	.072	.084	.080
25	29.521	29.343	29.288	29.384	20	34	32	22	40	36	22.7	41	21	.085	.118	.144	.116
26	29.273	29.253	29.248	29.258	33	39	41	36	43	43	40.7	45	36	.149	.186	.231	.189
27	29.116	28.979	28.989	29.028	39	45	43	43	48	46	45.7	53	42	.186	.260	.238	.228
28	29.056	29.066	29.166	29.096	29	29	30	33	33	32	32.7	50	31	.114	.114	.144	.124
29	29.134	29.032	29.187	29.118	27	30	30	30	33	31	31.3	36	31	.113	.132	.155	.133
30	29.271	29.388	29.431	29.363	22	25	25	25	29	29	27.7	35	25	.084	.089	.089	.087
Means....	29.359	29.332	29.361	29.350	....	....	....	35.3	42.7	39.1	39.0	....	....	.145	.162	.166	.158
Dec. 1	29.604	29.471	29.418	29.498	16	28	31	17	33	33	27.7	39	17	.078	.096	.151	.108
2	29.288	29.182	29.244	29.238	27	38	40	30	44	45	39.7	49	30	.113	.151	.182	.149
3	28.966	28.873	28.926	28.922	42	44	39	45	47	42	44.7	49	43	.228	.249	.199	.225
4	29.046	29.046	29.295	29.129	30	38	33	33	43	36	37.3	46	33	.132	.164	.149	.148
5	29.465	29.488	29.543	29.499	29	39	40	31	43	43	39.0	45	31	.137	.186	.208	.177
6	29.408	29.400	29.460	29.423	40	42	38	42	45	40	42.3	47	41	.221	.228	.203	.217
7	29.375	29.250	29.011	29.212	37	38	37	39	41	39	36.3	45	39	.194	.190	.194	.193
8	28.615	28.898	29.169	28.894	32	24	19	34	27	22	27.7	42	22	.155	.095	.069	.106
9	29.135	29.195	29.248	29.193	11	7	9	12	9	11	10.7	25	8	.061	.037	.043	.047
10	29.302	29.305	29.310	29.306	5	11	12	7	13	14	11.3	17	5	.032	.049	.052	.044
11	29.335	29.385	29.475	29.398	4	5	3	5	8	5	06.0	17	4	.041	.021	.027	.030
12	29.600	29.608	29.618	29.609	- 2	9	10	- 1	12	13	08.0	15	- 2	.028	.031	.034	.031
13	29.276	29.525	29.640	29.480	11	15	9	14	18	11	14.3	21	10	.037	.052	.043	.044
14	29.780	29.782	29.830	29.797	16	21	22	18	24	25	22.3	28	11	.067	.079	.084	.077
15	29.694	29.513	29.351	29.519	20	23	23	25	26	27	26.0	29	23	.050	.089	.078	.072
16	29.100	29.105	29.237	29.147	25	25	19	27	27	22	25.3	30	21	.112	.112	.069	.098
17	29.371	29.448	29.494	29.438	12	24	22	14	28	25	22.3	31	14	.052	.083	.084	.073
18	29.469	29.358	29.411	29.413	16	27	30	18	30	32	26.7	33	15	.067	.113	.144	.108
19	29.431	29.562	29.720	29.571	31	25	20	33	29	23	28.3	35	22	.151	.089	.074	.105
20	29.842	29.792	29.689	29.774	20	19	21	22	23	25	23.3	27	20	.085	.058	.067	.070
21	29.504	29.362	29.284	29.383	25	26	31	27	29	32	29.3	33	25	.112	.106	.162	.127
22	28.999	28.874	28.826	28.900	35	37	37	37	40	39	38.7	44	32	.178	.181	.194	.184
23	28.775	28.846	28.904	28.842	35	31	27	37	34	32	34.3	41	32	.178	.139	090	.136
24	28.942	28.999	29.152	29.031	24	20	14	28	25	18	23.7	33	16	.083	.050	.037	.057
25	29.248	29.381	29.243	29.291	8	16	21	11	21	25	19.0	27	10	.028	.033	.067	.043
26	29.236	29.217	29.317	29.257	12	14	7	14	17	10	13.7	29	8	.052	.048	.026	.042
27	29.478	29.520	29.623	29.540	0	5	2	2	7	5	04.7	16	2	.021	.032	.014	.022
28	29.688	29.666	29.713	29.689	0	9	3	2	14	7	07.7	17	2	.021	.009	....	.015
29	29.695	29.600	29.610	29.635	0	5	- 3	2	8	- 1	03.0	12	- 1	.021	.021	.015	.019
30	29.575	29.454	29.385	29.471	- 6	11	15	- 5	9	19	07.7	20	- 5	.021	....	.040	.030
31	29.325	29.415	29.640	29.460	18	15	4	20	18	6	14.7	23	5	.076	.052	.030	.053
Means....	29.341	29.339	29.380	29.353	....	....	....	20.6	25.5	23.4	23.2	....	....	.091	.095	.095	.092

the northern and northwestern lakes at Milwaukee, Wisconsin.

VAPOR.				WIND.								Amount of cloudiness. (0 = clear sky.) (10 = sky entirely overcast.)			Amount of evaporation, in U. S. inches and decimals.	Amount of rain or melted snow, in U. S. inches and decimals.
Humidity. Saturation = 1,000.				Direction. From whence.			Velocity, in miles, per hour.			Resultant velocity, in miles, per hour.	Resultant direction					
7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.			7 a. m.	2 p. m.	9 p. m.		
											°					
.547	.411	.847	.602	SW ...	W. SW	N	1.8	3.7	1.5	1.7	S. 77 W	5	0	5	......	......
.617	.446	.712	.592	Calm ..	W.NW	Calm ..	0	1.7	0	0.7	N. 75 W.	1	3	0	......	......
.712	.483	.833	.676	Calm ..	Calm ..	E.NE .	0	0	0.4	0.1	N. 71 E	10	10	10	......	......
.645	.547	.450	.547	E.NE .	NE ...	E.NE .	2.2	3.7	2.0	2.0	N. 55 E	9	9	0	......	......
.557	.567	.645	.590	SE	SE	S.SE ..	0.5	0.7	0.6	0.3	S. 17 E	10	7	0	......	......
.694	.543	.719	.652	SW ...	S.SE ..	Calm ..	0.3	1.2	0	0.3	S. 14 E.	0	8	0	......	......
.628	.535	.472	.512	SW ...	S.SE ..	SW ...	0.1	2.0	2.5	1.3	S. 20 W.	0	0	5	......	......
.727	.381	.607	.572	W.NW	W.NW	Calm ..	1.2	3.4	0	1.7	N. 71 W.	2	0	0	......	.02
.587	.777	.386	.583	W.NW	W.NW	W.NW	1.0	2.0	0.5	1.2	N. 74 W.	0	0	0	......	......
.619	.698	.829	.715	Calm ..	E.NE .	Calm ..	0	0.5	0	0.2	N. 69 E.	5	10	10	......	.33
.712	.645	.557	.638	NW ...	NW ...	NW ...	3.0	2.1	1.4	2.0	N. 45 W.	5	10	10	......	......
.788	.661	.807	.752	Calm ..	S. SE ..	Calm ..	0	0.9	0	0.3	S. 21 E.	0	0	0	......	......
.669	.607	.624	.633	S.SE ..	S. SE ..	S.SE ..	2.9	3.5	3.6	3.3	S. 22 E	5	3	10	......	.30
.767	.511	.661	.646	S.SW .	W.SW.	W. SW	1.2	4.0	1.1	2.0	S. 59 W.	10	7	10	......	......
.619	.636	.698	.651	W.NW	W.NW	Calm ..	0.2	1.5	0	0.7	N. 76 W.	10	1	2	......	......
.703	.476	.628	.602	Calm ..	N.NW .	Calm ..	0	1.5	0	0.7	N. 15 W.	8	8	9	......	......
.794	.533	.762	.696	Calm ..	SW ...	Calm ..	0	0.7	0	0.3	S. 45 W.	3	10	10	......	.06
.712	.684	.756	.717	Calm ..	Calm ..	Calm ..	0	0	0	0.0	Calm ...	5	3	10	......	......
.719	.677	.597	.664	Calm ..	E.NE ..	N.NW .	0	0.2	1.4	0.6	N. 13 W.	3	2	8	......	......
.628	.500	.719	.616	N	N.NE .	Calm ..	0.9	0.8	0	0.6	N. 13 E	9	3	9	......	......
.712	.802	.712	.742	Calm ..	SW ...	Calm ..	0	0.5	0	0.2	S. 45 W.	8	10	10	......	.40
.800	......	.685	.743	N	N.NW .	N.NW .	0.4	1.6	0.3	0.7	N. 11 W.	10	10	1	......	......
.569	.694	.556	.606	N. NE .	N. NE .	N. NE .	0.5	0.6	0.7	0.7	N. 17 E.	10	10	10	......	......
.721	.449	.622	.597	NW ...	W.NW	W.NW	1.0	2.2	0.2	1.0	N. 61 W.	0	3	8	......	......
.721	.476	.628	.608	Calm ..	SW ...	SW ...	0	2.6	1.2	4.7	S. 45 W.	0	0	2	......	......
.705	.669	.833	.736	S.SW .	Calm ..	S.SE ..	0.4	0	0.4	0.2	South ..	10	10	10	......	......
.669	.777	.767	.738	S.SE ..	S.SE ..	W.....	0.4	0.6	1.2	0.3	S. 61 W.	10	10	5	......	0.9
.606	.606	.794	.669	W.....	W.....	W.NW	0.8	1.2	0.2	0.7	West ...	10	10	10	......	......
.675	.703	.893	.757	Calm ..	W.NW	Calm ..	0	0.3	0	0.2	N. 71 W.	10	10	10	......	.12
.622	.089	.089	.267	NW ...	W.NW	Calm ..	1.4	1.4	0	1.0	N. 71 W.	10	5	10	......	......
.675	.571	.663	.636	....	....	....	....	....	....	0.4	S. 74 W.	5.9	5.7	6.1	......	1.32
.834	.510	.800	.715	Calm ..	S.SE ..	S.SW .	0	0.5	0.3	0.2	South ..	10	0	0	......	......
.675	.522	.607	.601	S.SW .	S SE ..	S.SW .	0.2	0.6	2.0	1.0	S. 11 W.	0	0	5	......	......
.762	.772	.744	.759	S.SW .	S.SW .	W.NW	2.2	1.2	0.9	1.0	S. 41 W.	10	10	10	......	.59
.703	.587	.705	.665	W.NW	W.NW	Calm ..	0.5	0.7	0	0.3	S. 75 W.	0	0	0	......	......
.788	.669	.750	.736	Calm ..	NE	E.NE .	0	0.6	0.4	0.3	N. 61 E	2	10	10	......	.32
.829	.762	.820	.804	Calm ..	W.NW	W.NW	0	0.7	0.9	0.6	N. 75 W.	10	10	10	......	......
.816	.738	.816	.790	W.SW.	SW ...	NE ...	0.2	0.4	0.2	0.1	N. 71 W.	10	10	10	......	.83
.792	.644	.581	.673	N	NW ...	Calm ..	0.4	2.5	0	1.0	N. 19 W.	10	10	0	......	.26
.804	.568	.596	.656	W.NW	W.NW	W.NW	1.6	2.9	2.4	2.3	N. 68 W.	1	1	9	......	.02
.538	.623	.635	.599	W.NW	W.NW	W	0.8	2.3	1.2	1.6	N. 77 W.	0	1	0	......	......
.750	.334	.500	.528	W.NW	W.NW	W.NW	1.0	2.5	1.8	1.7	N. 69 W.	9	0	0	......	......
.683	.418	.438	.513	W.NW	W.NW	W.NW	1.5	0.9	0.4	1.0	N. 73 W.	0	0	0	......	......
.457	.525	.596	.526	N.NE..	N.NE .	N.NE .	0.2	0.6	0.3	0.3	N. 23 E	10	10	0	......	.07
.682	.610	.622	.638	N	E	E	1.4	0.5	0.2	0.3	N. 67 E.	10	10	10	......	......
.378	.634	.529	.514	E.SE ..	E	E	1.0	2.0	2.8	2.0	S. 81 E.	10	10	10	......	......
.761	.761	.584	.702	NE....	N.NE .	N.NW.	4.8	2.8	0.5	2.7	N. 32 E.	10	10	5	......	.80
.635	.543	.622	.600	Calm ..	Calm ..	Calm ..	0	0	0	0.0	Calm ...	0	9	10	......	......
.682	.675	.794	.717	Calm ..	W.SW.	Calm ..	0	0.5	0	0.3	S. 65 W.	10	10	10	......	......
.800	.556	.598	.651	Calm ..	NE....	NE ..	0	2.7	1.3	1.3	N. 45 E	10	10	10	......	.02
.721	.467	.500	.563	E.SE ..	S.SE ..	S.SE ..	0.5	1.5	3.0	1.7	S. 24 E.	10	10	8	......	.01
.761	.665	.896	.774	S,SW..	S.SW .	S.SW .	0.5	0.3	0.9	0.7	S. 18 W.	10	10	10	......	.02
.807	.732	.816	.785	S.SW..	S.SW .	Calm ..	0.8	0.6	0	0.6	S. 14 W.	10	10	10	......	.06
.807	.712	.496	.672	Calm ..	N.NW.	NW ...	0	1.2	1.6	1.0	N. 29 W.	10	10	10	......	......
.543	.378	.371	.431	NW ...	NW ...	NW ...	0.7	1.6	2.1	1.3	N. 45 W.	10	5	10	......	......
.398	.293	.500	.397	NW ...	W.....	W.....	1.5	1.7	0.2	1.0	N. 70 W.	0	0	10	......	......
.635	.509	.377	.507	NW ...	NW ...	NW ...	1.1	2.0	2.5	1.7	N. 45 W.	6	9	0	......	......
.438	.538	.253	.410	NW ...	NW ...	NW ...	2.0	3.0	0.8	2.0	N. 45 W.	0	0	0	......	......
.438	.106	......	.272	NW ...	NW ...	NW ...	0.9	2.1	0.6	1.3	N. 45 W.	0	0	0	......	......
.438	.334	.369	.380	NW ...	W.NW	NW ...	0.2	2.1	0.4	1.0	N. 69 W.	0	0	0	......	......
.627	......	.392	.510	W.NW	Calm ..	S.SW .	0.2	0	1.1	0.6	S. 21 W.	0	10	10	......	......
.702	.525	.520	.582	SW ...	W.NW	NW ...	0.2	2.3	2.4	1.3	N. 53 W.	10	5	0	......	......
.667	.557	.594	.632	....	....	....	....	....	....	0.5	N. 53 W.	6.1	6.3	5.7	......	3.00

Reductions of the monthly meteorological register of the survey of

Date.	Barometer reduced to temperature of 32° Fahr., expressed in United States inches and decimals.				TEMPERATURE—FAHRENHEIT.									VAPOR.			
					Wet bulb, or point of evaporation.			Dry bulb, or temperature of the open air.				Maximum.	Minimum.	Elasticity, in U. S. inches and decimals.			
	7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	Mean.			7 a. m.	2 p. m.	9 p. m.	Mean.
1866.					°	°	°	°	°	°	°	°	°				
July 1	29.510	29.503	29.511	29.508	56	65	54.5	60	69	57	62.0	....	50	.396	.819	.392	.536
2	29.438	29.374	29.335	29.382	60	68	68	65	72.5	70	69.2	....	61.5	.451	.624	.658	.578
3	....	29.158	29.155	29.157	....	70	68	....	73	71	72.0	....	61.5	.....	.693	.644	.669
4	29.250	29.221	29.198	29.223	71	70	68	73	74	71	65.5	....	53	.731	.679	.644	.685
5	....	29.078	....	29.078	....	66	....	....	68	....	68.0	....	....	.....	.612	.....	.612
6	28.992	....	29.388	29.190	57	....	68	60	....	71	65.5	....	60	.426	.....	.644	.535
7	....	29.159	....	29.159	....	78	....	....	81	....	81.0	....	....	.....	.918	.....	.918
8	29.266	29.315	28.913	29.165	65	67	64	68	71	67	68.7	....	66	.577	.608	.556	.580
9	29.569	29.574	29.584	29.576	55	62	58	58	65	62	61.7	....	55	.393	.516	.423	.444
10	29.567	29.518	29.450	29.512	52	67	56	56	72	58	62.0	....	46	.335	.595	.422	.451
11	29.492	29.418	29.420	29.443	52	70	72	55	75	74	68.0	....	46	.349	.666	.757	.591
12	29.418	29.333	....	29.378	68	77	....	72	83	....	77.5	....	....	.631	.860	.....	.746
13	29.270	29.218	29.262	29.250	73	81	72	77	88	76	80.3	....	70	.757	.962	.731	.817
14	29.312	29.249	29.287	29.283	71	75	79	75	81	83	79.7	....	66.5	.704	.787	.936	.809
15	29.309	29.268	29.293	29.290	74	80	84	78	86	89	84.3	....	72	.785	.942	1.096	.941
16	29.363	29.345	29.390	29.363	73	72	70	78	77	73	76.0	....	73	.744	.718	.693	.719
17	....	29.283	29.271	29.277	....	64	61	....	67	64	65.5	....	63	.....	.556	.497	.518
18	29.321	29.125	29.241	29.229	55	66	70	58	71	74	67.7	....	63.5	.393	.572	.679	.548
19	29.297	29.243	29.203	29.248	60	70	64	64	74	70	69.3	....	57	.465	.679	.516	.553
20	29.159	29.228	29.235	29.207	55	71	68	59	74	72	68.3	....	60	.380	.718	.631	.576
21	29.342	29.332	29.469	29.381	83	82	78	85	86	83	84.7	....	76	1.101	1.038	.890	1.030
22	29.333	29.375	29.330	29.346	73	72	70	78	77	73	76.0	....	73	.744	.718	.693	.718
23	29.230	29.162	29.193	29.195	63	73	71	65	77	74	72.0	....	62	.549	.757	.718	.675
24	29.325	29.328	29.331	29.328	60	67	62	63	70	65	66.0	....	60	.478	.622	.516	.505
25	29.376	29.298	29.335	29.336	55	72	69	58	78	74	70.0	....	60.5	.393	.704	.641	.579
26	29.381	29.388	29.493	29.421	64	70	67	65	73	70	69.3	....	50	.583	.693	.622	.633
27	29.484	29.420	29.392	29.432	61	63	70.5	63	68	74	68.3	....	57	.510	.509	.698	.572
28	29.413	29.375	29.318	29.369	64	71	70	68	79	75	74.0	....	67.5	.543	.651	.666	.620
29	29.290	29.270	29.264	29.275	64	73	73	69	77	77	74.3	....	63	.529	.757	.757	.681
30	29.225	29.230	29.230	29.228	65	71	71	68	75	74	72.3	....	58	.577	.704	.718	.666
31	29.311	29.311	....	29.311	61	64	....	64	71	....	67.5	....	....	.497	.503	.....	.333
Means..	*29.342	†29.303	‡29.314	29.308	....	....	....	66.7	41.7	69.3	71.2	....	....	.556	.706	.650	.672
Aug. 1	29.386	29.227	29.085	29.233	52	67	69.5	55	73	71	66.3	....	51	.349	.581	.701	.544
2	29.009	28.969	29.084	29.021	68	72	69	72.5	75	71	72.8	....	50.5	.624	.744	.682	.683
3	29.173	....	29.400	29.287	57	....	67.5	60	....	70	65.0	....	54.5	.426	.....	.639	.522
4	29.288	29.266	29.256	29.280	53	65	....	56	68	....	62.0	....	....	.363	.577	.....	.470
5	....	29.388	29.448	29.418	....	60	65	....	66	69	68.0	....	52	.....	.438	.564	.501
6	29.487	29.497	29.523	29.502	58	64	65	62	69.5	68	66.5	....	55	.429	.523	.577	.510
7	....	29.342	29.480	29.411	....	68	65.5	....	72	68	70.0	....	58	.....	.631	.595	.613
8	29.481	29.445	29.453	29.460	52	67	60	56	71	63	63.3	....	51.5	.335	.608	.478	.474
9	29.148	29.255	29.353	29.252	55	62	62	58	65	65	62.7	....	55	.393	.516	.516	.475
10	29.479	29.456	....	29.468	54	64	....	56.5	68	....	62.3	....	....	.385	.543	.....	.464
11	29.479	....	29.438	29.458	65	....	69	62	....	71	66.5	....	61	.577	.....	.682	.629
12	29.291	....	29.270	29.280	63	....	68	65	....	70	67.5	....	63	.549	.....	.658	.604
13	29.140	....	29.240	29.190	64	....	65	67.5	....	68	67.8	....	62.5	.556	.....	.577	.567
14	29.293	29.141	29.350	29.261	64	68	67.5	60	71	70.5	67.2	....	60	.516	.644	.626	.595
15	29.628	29.688	29.731	29.682	57	55	52	60	59	55	58.0	....	53	.426	.380	.349	.385
16	29.709	29.655	29.628	29.661	42	59	56	45	64	60	56.3	....	32	.228	.433	.396	.352
17	29.538	29.491	....	29.514	49	64	....	52	69	....	60.5	....	....	.308	.529	.....	.419
18	29.413	....	29.316	29.264	57	....	62	60	....	63	61.5	....	57.5	.426	.....	.542	.484
19	....	29.256	29.304	29.280	....	61	58	....	65	61	63.0	....	56.5	.....	.483	.443	.463
20	29.332	....	29.203	29.268	46	....	57	47	....	59	53.0	....	44	.297	.....	.439	.268
21	29.233	....	....	29.233	51	...	....	53	...	....	53.0	....	....	.348	.....	.....	.348
22	29.248	29.226	29.266	29.247	44	52	49	46	55	52.5	51.2	....	52	.262	.349	.302	.304
23	29.285	29.213	....	29.166	44	53	....	46	57	....	51.5	....	....	.262	.350	.....	.206
24	29.311	29.302	29.325	29.311	43	43	51	43	46	54	47.7	....	31.5	.278	.238	.335	.284
25	29.443	29.356	29.312	29.370	46	54	53	49	59	56	54.7	....	44.5	.271	.351	.363	.328
26	29.209	....	29.164	29.187	51	....	61	53	....	64	58.5	....	49	.348	.....	.497	.423
27	....	29.092	29.218	29.155	....	65	64	....	67	66	66.5	....	52	.....	.591	.569	.580
28	29.254	29.291	29.316	29.287	54	59	55	57	62	58	59.0	....	58	.378	.460	.393	.410
29	29.363	29.323	29.306	29.331	50	58	41	57	62.5	44.5	54.7	....	43	.268	.423	.211	.301
30	....	....	29.206	29.206	....	....	65	....	....	67	67.0	....	54	.....	.....	.591	.591
31	29.241	29.253	....	29.247	64	64	....	67.5	67.5	....	67.5	....	....	.549	.549	.....	.549
Means..	29.343	29.339	29.334	29.320	....	....	....	56.4	65.1	63.4	61.7	....	....	.390	.497	.509	.463

* Mean of 27 observations. † Mean of 30 observations. ‡ Mean of 27 observations.

the northern and northwestern lakes at Tawas City, Michigan.

VAPOR.				WIND.								Amount of cloudiness. (0=clear sky.) (10=sky entirely overcast.			Amount of evaporation in U. S. inches and decimals.	Amount of rain or melted snow, in U. S. inches and decimals.
Humidity. Saturation = 1,000.				Direction. From whence.			Velocity, in miles, per hour.			Resultant velocity, in miles, per hour.	Resultant direction.					
7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.			7 a. m.	2 p. m.	9 p. m.		
											°					
.765	.564	.843	.724	W	S	S	2	8	3	4.0	S. 10 W.	3	5	10	......	......
.731	.783	.898	.804	SW	S	SW	8	5	13	8.0	S. 37 W.	10	9	10	......	......
......	.854	.850	.852	......	S	SW	....	2	2	1.3	S. 21 W.	....	10	10	......	......
.902	.810	.830	.854	SW	SW	S	12	12	2	8.7	S. 41 W.	4	3	4	......	......
......	.895	......	.895	......	S	......	....	12	....	4.0	South	....	9	....	......	......
.822	......	.830	.836	SW	......	W	3	....	2	1.7	S. 65 W.	8	....	8	......	......
......	.868	......	.868	......	SW	......	....	35	....	11.7	S. 45 W.	....	9	....	......	......
.843	.802	.841	.829	W	NE	NW	10	16	23	10.3	N. 29 W.	5	5	0	......	.30
.816	.836	.748	.800	N	NE	NW	2	10	2	4.0	N. 28 E.	3	0	0	......	......
.747	.758	.876	.794	SE	SE	SW	2	2	2	0.7	S. 45 E.	2	4	0	......	......
.805	.768	.903	.859	SE	S	SW	2	10	2	4.3	South	3	1	0	......	......
.804	.787	......	.846	SW	W	......	2	18	....	6.7	S. 85 W.	0	4	....	......	......
.817	.727	.815	.786	W	W	W	6	27	4	12.3	West	1	7	8	......	......
.812	.744	.830	.795	S	S	S	4	8	2	4.7	South	2	5	3	......	......
.819	.758	.803	.793	S	SW	SW	8	20	2	9.3	S. 33 W.	10	10	0	......	......
.776	.774	.854	.801	SW	W	W	2	8	3	4.3	S. 84 W.	6	10	10	......	......
......	.841	.833	.837	......	NE	W	....	2	2	0.7	N. 16 W.	....	10	10	......	......
.816	.754	.810	.793	W	E	W	2	2	2	0.7	West	6	4	4	......	......
.780	.810	.704	.765	S	S	W	2	4	3	2.3	S. 25 W.	5	3	5	......	......
.761	.856	.804	.807	W	SE	W	2	2	2	1.0	S. 63 W.	8	5	0	......	......
.915	.836	.789	.847	S	S	SW	3	11	3	5.7	S. 7 W.	10	10	5	......	......
776	.774	.854	.801	SW	W	W	8	2	3	4.3	S. 83 W.	6	10	10	......	......
890	.817	.856	.854	SW	SW	SW	2	8	2	4.0	S. 45 W.	10	8	3	......	......
831	.848	.836	.838	SW	E	N	2	15	2	4.3	N. 87 E.	6	7	3	......	......
.816	.734	.764	.771	SE	S	W	2	4	3	2.0	S. 15 W.	0	2	3	......	......
.944	.854	.848	.882	NW	E	W	6	15	3	3.0	N. 62 E.	0	1	3	......	......
.886	.743	.833	.821	E	E	SW	2	4	2	1.7	S. 74 E.	1	6	10	......	......
.793	.657	.768	.739	N	E	NW	2	4	2	1.3	N. 40 E.	0	1	3	......	......
.747	.817	.817	.794	W	E	W	2	2	4	1.3	West	7	7	8	......	......
.843	.812	.856	.804	W	N	N	2	8	3	4.0	N. 10 W.	0	10	8	......	......
.833	.663	......	.748	N	E	......	2	16	....	5.7	N. 83 E.	0	7	....	......	......
.818	.785	.827	.814	......	......	......	....	....	....	2.1	S. 51 W.	4.3	6.1	4.9	......	.30
.805	.716	.923	.815	NW	SE	SW	4	4	3	1.0	S. 45 W.	10	7	10	......	......
.783	.858	.899	.847	SW	SW	SW	2	9	3	4.7	S. 45 W.	5	8	10	......	.06
.822	......	.872	.847	NW	......	NW	15	....	3	6.0	N. 45 W.	10	....	5	......	......
.809	.843	......	.826	W	NW	S	2	2	4	1.3	S. 50 W	3	10	10	......	......
......	.685	.796	.740	......	NW	NW	....	12	2	4.7	N. 45 W.	....	0	0	......	......
.772	.725	.843	.780	NW	NW	NW	2	15	2	6.3	N. 45 W.	0	3	0	......	......
......	.804	.869	.837	......	SE	W	....	2	2	0.7	S. 17 W.	....	6	3	......	......
.747	.802	.831	.793	W	S	W	2	2	2	1.7	S. 67 W.	6	1	3	......	......
.816	.836	.836	.829	NW	NW	NW	6	12	2	6.7	N. 45 W.	5	6	5	......	.94
.842	.793	......	.818	NW	E	......	2	2	....	0.7	N. 17 W.	1	2	....	......	.06
.843	......	.899	.871	SE	......	SE	5	....	6	3.6	S. 45 E.	5	....	8	......	.10
.890	......	.898	.894	S	......	S	20	....	6	8.7	South	10	....	6	......	.36
.841	......	.843	.842	NW	......	NW	5	....	12	5.7	N. 45 W.	10	....	10	......	.27
.704	.850	.825	.793	W	S	SW	12	15	12	10.3	S. 41 W.	8	10	8	......	......
.822	.761	.805	.796	NE	NE	N	28	4	8	12.7	N. 36 E.	10	10	0	......	.26
.762	.727	.765	.751	W	SE	W	2	2	12	4.3	S. 84 W.	0	0	0	......	......
.794	.747	......	.770	W	S	......	2	15	....	4.3	S. 9 W.	1	8	....	......	......
.822	......	.942	.822	W	......	NW	12	....	2	4.7	N. 84 W.	10	....	10	......	......
......	.783	.825	.804	......	N	W	....	5	2	2.0	N. 19 W.	....	5	1	......	.05
.923	......	.878	.900	NW	......	S	4	....	6	1.3	S. 37 W.	10	....	8	......	.05
.864	......	......	.864	W	......	......	9	....	....	3.0	West	4	....	....	......	.54
.843	.805	.763	.804	W	NW	NW	2	8	2	4.0	N. 54 W.	4	6	1	......	......
.843	.752	......	.797	NW	NW	......	8	15	....	7.7	N. 45 W.	4	9	....	......	......
1.000	.767	.802	.836	W	W	W	2	5	12	6.3	West	1	8	5	......	......
.781	.703	.809	.764	W	SW	W	5	8	6	5.7	S. 71 W.	3	9	5	......	.06
.864	......	.833	.848	SW	......	SW	2	....	2	1.3	S. 45 W.	5	....	9	......	......
......	.893	.891	.892	......	S	W	....	15	2	5.3	S. 8 W.	....	10	10	......	......
.812	.828	.816	.819	W	NE	NW	2	2	2	1.0	N. 41 W.	10	10	10	......	......
.577	.748	.720	.682	W	S. SE	N	2	5	2	1.0	S. 11 W.	1	9	7	......	......
......	......	.893	.893	......	......	SW	....	....	12	4.0	S. 45 W.	....	....	5	......	......
.817	.817	......	.817	SE	NE	......	6	2	....	2.0	S. 62 E.	10	10	....	......	......
.815	.784	.843	.820	......	......	......	....	....	....	1.9	N. 89 W.	5.6	6.7	5.7	......	2.75

Reductions of the monthly meteorological register of the survey of

Date.	Barometer reduced to temperature of 32° Fahr., expressed in United States inches and decimals.				TEMPERATURE—FAHRENHEIT. Wet bulb, or point of evaporation.			TEMPERATURE—FAHRENHEIT. Dry bulb, or temperature of the open air.				Maximum.	Minimum.	VAPOR. Elasticity, in U. S. inches and decimals.			
	7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	Mean.			7 a. m.	2 p. m.	9 p. m.	Mean.
1866.					°	°	°	°	°	°	°	°	°				
Sept. 1	29.198	....	29.065	29.131	66	....	68	67	....	70	68.5	....	57	.626	....	.658	.642
2	29.070	....	29.085	29.078	65	....	63	67	....	68	67.5	....	62	.591	....	.377	.484
3	29.380	29.294	29.414	29.363	56	64	59	58.5	69	62	63.2	....	50	.416	.529	.460	.468
4	29.304	....	29.178	29.241	56	....	62	58.5	....	66	62.3	....	55.5	.416	....	.502	.459
5	29.270	29.257	29.258	29.262	54	59	59	57	65.5	63	61.8	....	50	.378	.413	.447	.413
6	29.291	29.328	29.440	29.353	53	59	55	55	62	57	58.0	....	52	.376	460	.407	.414
7	29.650	29.612	....	29.631	50	52	....	53	55	....	54.0	....	....	.321	.349	....	.225
8	29.446	29.388	29.408	29.414	51	61	63	55	65	66	62.0	....	52.5	.321	.483	.536	.447
9	29.308	29.271	....	29.289	60	59	....	62	62	....	62.0	....	....	.491	.460	....	.476
10	29.493	29.423	29.351	29.422	45	61	53	47	63	56	55.3	....	39.5	.273	.510	.363	.382
11	29.108	....	28.935	29.022	59	....	60	61	....	62	62.0	....	59	.473	....	.491	.482
12	28.960	29.097	29.005	29.021	57	62	55	60	64.5	58	60.8	....	57.5	.426	.522	.393	.447
13	29.170	29.198	29.214	29.194	49	55	55	51	60	58	53.6	....	48	.321	.367	.393	.360
14	29.188	29.269	29.462	29.306	48	52	43	51	56	45	50.7	....	43	.296	.315	.251	.294
15	29.609	29.574	29.550	29.578	35	48	51	37.5	53	54	48.2	....	34	.171	.269	.335	.258
16	....	29.306	29.250	29.278	....	55	57	....	58.5	60	59.2	....	52	....	.387	.426	.407
17	29.398	....	29.371	29.385	43	....	49	46	....	51	48.5	....	42	.238	....	.321	.279
18	29.370	29.286	29.311	29.322	43	47	47	48	50	50	49.3	....	45.5	.212	.283	.283	.226
19	29.347	....	29.460	29.404	45	....	46	47	....	49	48.5	....	43	.273	....	.271	.272
20	29.367	29.214	29.237	29.273	45	47	45	48	49	47	48.0	....	45	.260	.297	.273	.277
21	29.308	29.411	29.509	29.409	40	45	43	42.5	49	46.5	46.0	....	39	.215	.247	.232	.23
22	29.477	29.517	29.540	29.511	32	46	49	35	52	52	46.3	....	41	.142	.232	.318	.227
23	29.509	29.354	29.401	29.421	50	54	55	52	57	57	55.3	....	50	.334	.378	.407	.273
24	29.225	29.221	29.277	29.221	54	57	57	57	60	60	59.0	....	52	.378	.426	.426	.410
25	29.417	29.405	29.486	29.436	51	49	48	53.5	52	50	51.8	....	49	.341	.308	.309	.319
26	29.572	29.474	29.466	29.504	37	52	51	39	55	55	49.7	....	36.5	.194	.349	.321	.288
27	29.567	29.591	29.582	29.580	43	51	51	44	68	55	55.7	....	40.5	.264	.150	.321	.245
28	29.603	29.598	29.564	29.588	43	61	55	45.5	64	59	56.2	....	41	.245	.497	.380	.374
29	29.627	29.518	29.542	29.562	46	60	60	47	63	63	57.7	....	44	.297	.478	.478	.418
30	29.626	29.598	29.596	29.607	53	59	52	63	63	55	59.3	....	51	.310	.447	.349	.369
Means....	29.374	29.384	29.353	29.360	....	....	....	51.9	58.9	56.9	56.1	....	....	.327	.341	.383	.362
Oct. 1	29.540	29.411	29.348	29.433	38	59	60	41	62	63	55.3	....	45	.190	.460	.478	.376
2	29.273	29.254	29.475	29.334	57	59	46	58.5	64	50	57.5	....	40.5	.446	.433	.258	.376
3	29.535	29.655	29.756	29.649	43	44	40	46	48	43	45.7	....	40	.238	.236	.208	.227
4	29.805	29.776	29.743	29.775	45	47	47	47	52.5	50	49.8	....	36	.273	.250	.283	.269
5	29.695	29.630	29.554	29.626	36	53	57	39	57	60	52.0	....	37.5	.173	.350	.426	.316
6	29.437	29.416	29.319	29.391	54	52	54	56	55	56	55.7	....	52	.391	.349	.391	.374
7	29.462	29.441	29.487	29.463	51	54	52	53	56	55	54.7	....	50	.348	.391	.349	.363
8	29.536	29.571	....	29.554	51	52	....	54	55	....	54.5	....	....	.335	.349	....	.228
9	29.653	29.643	29.806	29.701	42	54	49	45	56.5	51	50.8	....	39	.228	.385	.321	.311
10	29.541	....	....	29.541	59	....	....	61	....	....	61.0	....	....	.473	....	....	.473
11	29.397	29.301	....	29.349	57	62	....	59	66	....	62.5	....	....	.439	.502	....	.470
12	29.266	29.274	....	29.270	56	56	....	59	59.5	....	59.4	....	....	.409	.403	....	.406
13	29.329	29.398	....	29.364	57	57	....	58.5	59	....	58.7	....	....	.446	.439	....	.442
14	29.893	29.884	29.907	29.895	36	56	50	40	59	54	51.0	....	....	.160	.409	.308	.292
15	29.794	29.746	29.709	29.750	40	60	50	42	63	54.5	53.2	....	39.5	.221	.478	.301	.333
16	29.506	29.447	29.426	29.460	41	59	53	44	62	57	54.3	....	33	.218	.460	.350	.343
17	29.344	29.318	29.268	29.310	39	55	59	41	60	62	54.3	....	36	.212	.367	.460	.346
18	29.301	29.355	29.406	29.354	57	56	55	60	59	57	58.7	....	57	.426	.409	.407	.414
19	29.427	29.406	29.301	29.378	47	54	56	49	57	59	55.0	....	44	.297	.378	.409	.361
20	29.061	29.094	29.214	29.123	40	39	35	42	42.5	38	40.8	....	37	.221	.192	.165	.193
21	29.348	29.447	29.509	29.435	30	33	30	33	36	34	34.3	....	30	.132	.149	.121	.134
22	29.108	29.035	....	29.072	57	58	....	60	61	....	60.5	....	....	.426	.443	....	.435
23	28.735	28.961	29.066	28.621	50	48	45	53	51	48	50.7	....	46	.321	.296	.260	.292
24	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
25	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
26	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
27	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
28	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
29	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
30	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
31	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Means....	29.434	29.430	29.546	29.428	....	....	....	49.6	56.4	52.4	53.5	....	....	.305	.369	.323	.338

the northern and northwestern lakes at Tawas City, Michigan.

VAPOR.				WIND.									Amount of cloudiness. (0 = clear sky.) (10 = sky entirely overcast.			Amount of evaporation, in U. S. inches and decimals.	Amount of rain or melted snow, in U. S. inches and decimals.
Humidity. Saturation = 1,000.				Direction. From whence.			Velocity, in miles per hour.			Resultant velocity, in miles per hour.	Resultant direction.						
7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.			7 a. m.	2 p. m.	9 p. m.		
.946	......	.898	.922	S	......	SW	10	....	5	4.7	S. 16 W.	10	....	10	......	.22
.893	......	.843	.868	W	......	W	10	....	2	4.0	West	3	....	5	......	.10
.817	.747	.828	.807	SW	S	W	12	13	12	10.0	S. 44 W.	0	5	5	......	......
.847	......	.786	.817	SW	......	SW	12	....	12	8.0	S. 45 W.	10	....	10	......	......
.812	.638	.776	.749	W	SW	W	2	20	3	8.0	S. 54 W.	5	9	5	......	......
.869	.828	.874	.657	SW	SE	W	5	16	2	5.3	S. 21 E.	10	10	0	......	......
.798	.805	......	.802	W	W	......	6	3	....	3.0	West	10	10	....	......	......
.743	.783	.838	.788	SW	S	S	5	8	9	7.0	S. 9 W.	7	5	10	......	.02
.884	.828	......	.856	S	SW	......	13	8	....	6.3	S. 16 W.	10	10	....	......	.04
.847	.886	.809	.847	SW	SW	SW	6	11	8	8.3	S. 45 W.	8	5	10	......	......
.882	......	.884	.882	NE	......	NE	18	....	10	9.3	N. 45 E.	10	....	10	......	......
.822	.862	.816	.833	SW	SW	SW	8	35	11	18.0	S. 45 W.	10	6	0	......	......
.859	.768	.816	.794	SW	W	SW	8	11	6	7.7	S. 65 W.	....	8	5	......	......
.790	.747	.840	.792	W	W	W	10	35	5	16.7	West	8	5	3	......	......
.762	.667	.802	.744	W	SE	S	3	15	20	10.3	S. 14 E.	0	1	10	......	1.72
......	.788	.822	.805	......	S	S	....	15	6	7.0	South	....	10	10	......	......
.767	......	.859	.812	W	......	W	6	....	2	2.7	West	8	....	5	......	.40
.631	.786	.786	.734	W	NW	W	3	3	3	3.0	N. 75 W.	10	10	8	......	......
.847	......	.781	.814	NW	......	NW	16	....	3	6.3	N. 45 W.	10	....	8	......	......
.777	.853	.847	.826	NE	NE	NE	11	25	16	17.3	N. 45 E.	10	10	10	......	......
.789	.710	.732	.744	NW	NW	NW	16	16	3	11.7	N. 45 W.	8	7	0	......	.01
.698	.598	.794	.697	W	S	S	3	5	25	10.3	S. 6 W.	0	0	8	......	......
.861	.812	.874	.849	S	E	S	20	20	11	12.7	S. 33 E.	10	10	9	......	......
.812	.822	.822	.819	E	S	SW	18	20	50	19.3	S. 18 W.	10	10	10	......	......
.832	.794	.856	.827	NW	N	W	2	2	2	1.3	N. 45 W.	0	0	9	......	......
.816	.805	.743	.788	W	S	SW	2	10	3	4.3	S. 18 W.	0	0	0	......	......
.918	.219	.743	.627	NW	S	NW	2	2	2	1.0	N. 75 W.	0	0	0	......	......
.803	.833	.761	.799	W	S	NW	2	8	2	2.3	S. 29 W.	0	0	0	......	......
.923	.831	.831	.862	NW	S	W	2	11	2	3.3	S. 20 W.	0	0	0	......	......
.599	.776	.805	.727	SW	NE	W	10	6	2	1.7	S. 55 W.	0	0	0	......	......
.816	.756	.788	.803	......	......	......	....	....	....	4.0	S. 38 W.	5.9	5.4	5.7	......	2.51
.738	.828	.831	.799	W	S	SW	12	10	5	7.0	S. 49 W.	0	10	0	......	......
.907	.727	.716	.783	SW	NE	NE	2	8	6	4.0	N. 45 E.	1	10	10	......	......
.767	.704	.750	.740	N	NE	N	6	11	3	6.0	N. 26 E.	8	5	5	......	......
.847	.633	.786	.755	SE	SE	SE	5	13	16	11.3	S. 45 E.	3	6	8	......	......
.726	.752	.822	.767	SE	SE	SE	3	8	11	7.3	S. 45 E.	0	0	8	......	......
.872	.805	.872	.850	N	N	NE	2	5	13	6.3	N. 29 E.	10	10	10	......	......
.864	.872	.805	.847	NE	NE	NE	10	10	3	7.7	N. 45 E.	10	10	10	......	......
.802	.805	......	.804	NE	NE	......	3	8	....	3.7	N. 45 E.	10	10	....	......	......
.762	.842	.859	.821	W	E	W	3	12	3	2.0	East	0	1	10	......	......
.882	......	......	.882	SW	......	......	3	....	....	1.0	S. 45 W.	1	3	....	......	......
.878	.786	......	.842	S	SE	......	3	3	....	2.0	S. 20 E.	10	10	....	......	......
.819	.791	......	.805	SE	NE	......	4	4	....	1.9	East	10	10	....	......	......
.907	.878	......	.894	NE	NE	......	6	8	....	4.7	N. 45 E.	0	0	0	......	......
.645	.819	.738	.734	W	E	W	2	10	13	1.7	West	0	3	0	......	......
.829	.831	.709	.790	W	S	W	2	5	2	2.3	S. 35 W.	0	0	0	......	......
.756	.828	.752	.779	W	S	W	2	6	2	2.7	S. 30 W.	0	2	5	......	......
.824	.708	.828	.787	W	S	SE	2	10	13	7.0	S. 20 E.	10	9	0	......	......
.822	.819	.874	.838	SW	SW	SW	5	8	6	6.3	S. 45 W.	0	10	5	......	......
.853	.812	.819	.828	W	SE	SE	2	5	8	4.0	S. 37 E.	8	10	0	......	......
.829	.706	.719	.751	W	W	W	30	30	2	20.7	West	5	10	0	......	......
.703	.705	.617	.675	NW	NW	NW	8	15	6	9.7	N. 45 W.	10	10	....	......	.06
.822	.825	......	.824	S	S	......	10	3	....	4.3	South	10	9	8	......	.20
.798	.790	.777	.788	W	W	W	45	45	25	38.3	West	10	10	10	......	......
......	......	......	......	......	......	......	....	....	....	....	......	....	....	....	......	......
......	......	......	......	......	......	......	....	....	....	....	......	....	....	....	......	......
......	......	......	......	......	......	......	....	....	....	....	......	....	....	....	......	......
......	......	......	......	......	......	......	....	....	....	....	......	....	....	....	......	......
......	......	......	......	......	......	......	....	....	....	....	......	....	....	....	......	......
......	......	......	......	......	......	......	....	....	....	....	......	....	....	....	......	......
......	......	......	......	......	......	......	....	....	....	....	......	....	....	....	......	......
......	......	......	......	......	......	......	....	....	....	....	......	....	....	....	......	......
.811	.785	.781	.799	......	......	......	....	....	....	1.7	S. 75 W.	5.0	6.4	5.2	......	.26

Reductions of the monthly meteorological register of the survey of

Date.	Barometer reduced to temperature of 32° Fahr., expressed in United States inches and decimals.				TEMPERATURE—FAHRENHEIT.									VAPOR.			
					Wet bulb, or point of evaporation.			Dry bulb, or temperature of the open air.				Maximum.	Minimum.	Elasticity, in U. S. inches and decimals.			
	7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	Mean.			7 a. m.	2 p. m.	9 p. m.	Mean.
1866.					°	°	°	°	°	°	°	°	°				
Nov. 1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
3	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
4	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
5	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
6	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
7	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
8	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
9	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
10	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
11	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
12	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
13	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
14	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
15	29. 111	29. 103	29. 167	29. 127	43	40	39	47	44	41	44. 0	....	36	. 225	. 195	. 212	. 211
16	29. 164	29. 292	29. 087	29. 181	40	43	37	42	46	41	43. 0	....	35. 5	. 221	. 238	. 168	. 209
17	29. 470	29. 460	29. 455	29. 462	38	40	37	41	43	39	41. 0	....	32. 5	. 190	. 208	. 194	. 197
18	29. 066	28. 981	29. 043	29. 030	38	41	40	40	43	42	41. 7	....	32	. 203	. 231	. 221	. 218
19	29. 096	29. 169	29. 265	29. 177	37	37	33	39	40	35	38. 0	....	35	. 194	. 181	. 162	. 179
20	29. 309	29. 326	29. 300	29. 312	30	30	31	32	32	33	32. 0	....	30	. 144	. 144	. 151	. 146
21	29. 136	29. 199	29. 362	29. 232	31	32	29	33	34	31	32. 7	....	29	. 151	. 155	. 137	. 148
22	29. 453	29. 432	29. 530	29. 472	27	29	28	28	31	30	29. 7	....	27. 5	. 136	. 137	. 130	. 134
23	29. 470	29. 432	29. 514	29. 472	24	28	28	26	29. 5	30	28. 5	....	24	. 106	. 136	. 130	. 124
24	29. 573	29. 472	29. 412	29. 432	22	33	28	24	34	30	29. 3	....	22	. 095	. 175	. 130	. 133
25	29. 343	29. 352	....	29. 348	32	34	....	34	36	....	35. 0	....	....	. 155	. 170	....	. 163
26	....	....	29. 148	29. 148	....	....	40	....	....	42	42. 0	....	36	....	....	. 221	. 221
27	28. 983	28. 958	28. 935	28. 959	43	44	39	45	46	42	44. 3	....	37	. 251	. 262	. 199	. 237
28	29. 121	....	29. 136	29. 129	32	....	33	34	....	35	34. 5	....	31. 5	. 155	....	. 162	. 158
29	29. 161	29. 187	....	29. 174	31	33	....	33. 5	35	....	34. 3	....	....	. 145	. 162	....	. 154
30	29. 553	29. 517	29. 477	29. 516	24	28	28	26	30	30	28. 7	....	24	. 106	. 130	. 130	. 122
Means....	29. 267	29. 277	29. 273	29. 262	....	....	....	34. 9	34. 9	35. 8	39. 9	....	....	. 165	. 180	. 167	. 172
Dec. 1	29. 378	29. 347	....	29. 363	26	33	....	29	36	....	32. 5	....	....	. 106	. 149	....	. 128
2	29. 134	29. 048	29. 066	29. 083	37	41	39	39	43	41	41. 0	....	26	. 194	. 231	. 212	. 212
3	28. 981	29. 043	....	29. 012	39	42	....	41	45	....	43. 0	....	....	. 212	. 228	....	. 220
4	29. 456	29. 556	29. 513	29. 508	31	33	37	33	37	39	36. 3	....	33	. 151	. 136	. 194	. 160
5	29. 538	29. 385	29. 381	29. 435	34. 5	39	39	37	41	41	39. 7	....	33	. 154	. 212	. 212	. 193
6	29. 370	29. 237	29. 181	29. 263	35	42	38	37	44	41. 5	40. 8	....	35. 5	. 178	. 241	. 183	. 201
7	28. 525	28. 472	....	28. 499	39	40	....	40	44	....	42. 0	....	....	. 225	. 195	....	. 210
8	28. 899	28. 973	29. 057	29. 976	23	21	18	25	24. 5	20	23. 2	....	18	. 100	. 073	. 076	. 083
9	....	....	....	....	....	....	....	....	....	....	......	....	....	....	....	....	....
10	29. 096	29. 130	29. 246	29. 157	7	17	12	9	19. 5	15	14. 5	....	8	. 037	. 066	. 041	. 048
11	29. 157	29. 171	....	29. 164	15	17	....	17	19. 5	....	18. 3	....	....	. 063	. 066	....	. 065
12	29. 347	29. 431	29. 651	29. 476	10	15	10	13	17. 5	12	14. 2	....	11	. 034	. 057	. 046	. 046
13	....	29. 510	29. 571	29. 540	....	16	17	....	18	20	19. 0	....	12	....	. 067	. 060	. 064
14	29. 774	29. 856	29. 476	29. 702	10	18	14	12	20	16	16. 0	....	9. 5	. 046	. 076	. 059	. 060
15	29. 732	29. 771	29. 563	29. 689	6	16	21	8	18	23	16. 3	....	6. 5	. 034	. 067	. 090	. 064
16	29. 170	29. 039	29. 094	29. 101	25	16	26	27. 5	18	28	24. 5	....	21	. 106	. 067	. 117	. 097
17	29. 173	29. 291	29. 443	29. 302	21	20	17. 5	23	23	19	21. 7	....	18	. 090	. 074	. 066	. 077
18	29. 511	29. 335	29. 330	29. 392	17	25	25	19	27	27	24. 3	....	20	. 071	. 112	. 112	. 098
19	....	29. 477	29. 727	29. 602	....	30	18	....	32	20	26. 0	....	17	....	. 144	. 076	. 110
20	29. 924	....	....	29. 924	6	....	....	8. 5	....	....	08. 5	....	....	. 029	....	....	. 029
21	29. 654	29. 512	....	29. 583	15	17. 5	....	17	19	....	18. 0	....	....	. 063	. 073	....	. 068
22	29. 134	29. 081	29. 084	29. 100	27	31	30	30	33	32	31. 7	....	29	. 113	. 151	. 144	. 136
23	28. 720	28. 710	28. 799	28. 743	35	38	38	36	39	40	38. 3	....	35	. 191	. 216	. 203	. 203
24	28. 808	29. 011	28. 961	28. 927	31	31	26	33	33	28	31. 3	....	22	. 151	. 151	. 117	. 140
25	29. 089	29. 048	29. 005	29. 047	18	21	18	20	23	20	21. 0	....	18. 5	. 076	. 090	. 076	. 081
26	29. 072	29. 066	29. 141	29. 093	18	21	21	20	23	24	22. 3	....	15. 5	. 076	. 090	. 079	. 082
27	29. 253	29. 283	29. 382	29. 306	12	15	11	15	18	13	15. 3	....	13	. 041	. 052	. 049	. 047
28	....	29. 430	29. 471	29. 450	....	13	11	....	16	13	09. 7	....	6	....	. 044	. 049	. 031
29	29. 492	29. 453	29. 471	29. 472	10	12	13	12	15	15	14. 0	....	6. 5	. 046	. 041	. 056	. 048
30	29. 557	29. 492	....	29. 525	10	13	....	13	16	....	09. 7	....	....	. 034	. 044	....	. 039
31	29. 380	29. 301	29. 442	29. 374	14	15	18	16	17	20	17. 7	....	9	. 059	. 063	. 076	. 066
Means....	29. 271	29. 257	29. 307	29. 327	....	....	....	23. 3	26. 8	20. 3	24. 3	....	....	. 099	. 113	. 104	. 103

the northern and northwestern lakes at Tawas City, Michigan.

VAPOR.				WIND.								Amount of cloudiness. (0 = clear sky.) (10 = sky entirely overcast.)			Amount of evaporation, in U. S. inches and decimals.	Amount of rain or melted snow, in U. S. inches and decimals.
Humidity. Saturation = 1,000.				Direction. From whence.			Velocity, in miles, per hour.			Resultant velocity, in miles, per hour.	Resultant direction.					
7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.			7 a. m.	2 p. m.	9 p. m.		
											°					
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.698	.677	.824	.733	NE	NE	NE	13	11	8	10.7	N. 45 E.	10	10	10	......	......
.829	.767	.653	.750	SW	SW	SW	13	8	17	12.7	S. 45 W.	10	10	10	......	.05
.738	.750	.816	.719	SW	SW	SW	9	10	10	9.7	S. 45 W.	10	10	10	......	.03
.820	.833	.829	.827	NW	SE	N	6	9	10	2.7	N. 16 E.	8	5	10	......	......
.816	.732	.797	.782	NW	NW	NW	12	12	4	9.3	N. 45 W.	10	10	10	......	.58
.794	.794	.800	.796	NW	NW	E	10	10	15	4.7	N. 3 E.	9	2	1	......	......
.800	.792	.788	.793	NE	NE	NE	18	14	15	15.7	N. 45 E.	10	10	10	......	......
.883	.788	.782	.818	N	NW	NW	2	8	2	4.0	N. 36 W.	10	10	10	......	......
.754	.834	.782	.790	W	W	W	6	10	2	6.0	West	10	9	4	......	......
.738	.895	.782	.805	W	S	S	8	12	12	8.7	S. 18 W.	10	10	10	......	......
.792	.802	......	.797	SW	SW	......	8	3	....	3.7	S. 45 W.	2	8	1	......	......
......	......	.829	.829	......	......	S	....	....	5	1.7	South	....	....	10	......	......
.840	.843	.744	.809	S	S	S	3	8	5	5.3	South	..	4	10	......	......
.792	......	.797	.794	SW	......	SW	2	....	3	1.7	S. 45 W.	10	10	9	......	.18
.756	.797	......	.777	SW	NW	......	3	5	....	2.0	N. 76 W.	10	....	10	......	.27
.754	.782	.782	.773	N	NW	W	5	5	4	3.7	N. 43 W.	10	9	....	......	.16
.787	.792	.786	.787	......	......	......	....	....	....	2.9	N. 27 W.	9.2	8.3	9.0	......	1.27
.665	.705	......	.685	S	S	......	8	12	....	6.7	South	0	1	....	......	......
.816	.833	.824	.824	S	S	S	10	10	16	12.0	South	8	10	10	......	......
.824	.762	......	.793	SW	W	......	10	20	....	6.7	S. 88 W.	10	4	....	......	.18
.800	.619	.816	.745	SW	SW	SW	3	3	6	4.0	S. 45 W.	8	0	5	......	......
.673	.824	.824	.774	NE	NE	SW	6	2	4	1.3	N. 45 E.	10	10	1	......	......
.807	.836	.699	.781	SW	SW	SW	8	6	12	8.7	S. 45 W.	10	0	10	......	......
.910	.677	......	.794	NE	SW	......	3	35	....	10.7	N. 45 E.	10	10	....	......	.70
.746	.554	.702	.667	SW	SW	SW	20	35	30	28.3	S. 45 W.	8	2	10	......	......
......	......	......	......	......	......	......	....	....	....	....	......	....	....	....	......	......
.568	.623	.475	.555	NW	W	W	13	30	12	17.3	N. 80 W.	5	9	0	......	......
.671	.623	......	.647	SW	W	......	19	20	....	12.0	S. 68 W.	8	10	....	......	......
.438	.597	.610	.548	W	W	W	19	20	13	17.3	West	8	8	8	......	......
......	.682	.556	.619	......	NW	NW	....	2	3	1.7	N. 45 W.	....	10	10	......	......
.610	.702	.659	.657	W	N	NW	3	3	5	3.0	N. 45 W.	0	9	8	......	......
.553	.682	.730	.635	SW	NW	NE	4	3	10	2.3	N. 18 E.	10	10	10	......	......
.707	.682	.768	.719	NE	NW	NW	16	10	13	9.3	N. 11 W.	8	10	10	......	......
.730	.598	.623	.630	NW	NW	W	10	10	10	9.3	N. 60 W.	8	1	0	......	......
.692	.761	.761	.738	S	S	S	14	18	11	14.3	South	10	10	10	......	......
......	.794	.702	.748	......	NW	NW	....	8	16	8.0	N. 45 W.	....	10	0	......	......
.452	......	......	.452	NW	......	......	19	....	....	6.3	N. 45 W.	10	....	....	......	.05
.671	.697	......	.684	S	S	......	25	20	...	15.0	South	10	8	....	......	......
.675	.800	.794	.756	S	S	S	8	10	5	7.7	South	10	10	10	......	......
.900	.907	.820	.876	S	S	S	5	8	6	6.3	South	10	10	10	......	.52
.800	.800	.768	.789	NW	SW	N	4	4	2	2.0	N. 71 W	10	10	10	......	......
.702	.730	.702	.711	W	W	W	6	5	8	6.3	West	10	10	10	......	......
.702	.730	.610	.681	W	W	W	6	3	8	5.7	West	10	5	0	......	......
.475	.525	.623	.541	NW	NW	NW	4	8	14	8.7	N. 45 W.	0	6	0	......	......
......	.492	.623	.558	......	NW	NW	....	16	9	8.3	N. 45 W.	....	4	1	......	......
.610	.475	.648	.578	NW	NW	N	3	15	5	7.3	N. 36 W.	10	10	10	......	......
.438	.492	......	.465	NW	W	......	5	4	....	2.7	N. 64 W.	9	5	....	......	......
.659	.671	.702	.677	SW	NW	NW	13	8	13	8.3	N. 77 W.	10	10	6	......	......
.677	.683	.668	.679	......	......	......	....	....	....	5.3	S. 72 W.	4.4	7.3	6.5	......	1.45

Reductions of the monthly meteorological register of the survey of

Date.	Barometer reduced to temperature of 32° Fahr., expressed in United States inches and decimals.				TEMPERATURE—FAHRENHEIT.									VAPOR.			
					Wet bulb, or point of evaporation.			Dry bulb, or temperature of the open air.				Maximum.	Minimum.	Elasticity, in U. S. inches and decimals.			
	7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	Mean.			7 a. m.	2 p. m.	9 p. m.	Mean.
1866.					°	°	°	°	°	°	°	°	°				
July 1	29.644	29.619	29.644	29.636	60	63	59	63	73	63	66.3	74	63	.478	.442	.776	.565
2	29.582	29.525	29.449	29.519	61	66	64	66	77	71	71.3	78	61	.470	.492	.503	.488
3	29.381	29.375	29.191	29.316	62	62	58	68	74	63	68.3	77	62	.476	.396	.416	.429
4	29.105	29.289	29.197	29.197	60	67	63	63	76	70	69.7	75	60	.478	.542	.482	.501
5	29.315	29.321	29.324	29.320	61	73	69	70	84	75	76.3	86	64	.416	.663	.628	.569
6	29.535	29.481	29.324	29.447	71	72	67	77	84	73	78.0	85	69	.678	.623	.581	.627
7	29.371	29.347	29.389	29.369	68	74	69	71	83	71	75.0	84	67	.644	.718	.682	.681
8	29.327	29.485	29.463	29.425	69	68	55	71	74	64	69.7	78	62	.682	.604	.314	.533
9	29.594	29.619	29.621	29.611	57	61	56	60	71	61	64.0	71	55	.426	.463	.383	.404
10	29.668	29.612	29.588	29.623	58	63	62	61	72	66	66.3	74	50	.443	.455	.502	.467
11	29.692	29.588	29.533	29.604	61	67	64	64	78	70	70.7	79	52	.497	.514	.516	.509
12	29.581	29.528	29.454	29.521	66	72	71	70	84	75	76.3	85	61	.586	.623	.704	.638
13	29.483	29.391	29.331	29.402	70	75	74	75	90	80	81.7	91	61	.666	.665	.758	.696
14	29.419	29.410	29.400	29.410	71	75	73	77	91	79	82.3	92	70	.678	.651	.730	.686
15	29.458	29.537	29.425	29.473	71	75	74	78	90	81	83.0	92	71	.664	.665	.745	.691
16	29.523	29.464	29.459	29.482	74	76	74	81	91	80	84.0	92	73	.745	.694	.758	.732
17	29.520	29.442	29.376	29.446	73	72	70	79	77	73	76.3	87	71	.730	.718	.693	.714
18	29.306	29.312	29.379	29.332	71	65	60	72	69	64	68.3	78	62	.745	.543	.465	.584
19	29.497	29.499	29.486	29.494	61	65	62	64	70	65	66.3	71	56	.497	.550	.516	.521
20	29.478	29.441	29.393	29.437	62	64	62	66	70	67	67.7	73	58	.502	.516	.489	.502
21	29.353	29.283	29.239	29.292	66	69	64	68	77	68	71.0	78	64	.612	.601	.543	.585
22	29.255	29.219	29.210	29.228	67	72	67	70	81	72	74.3	83	62	.622	.663	.595	.627
23	29.323	29.322	29.337	29.327	63	66	62	68	76	67	70.3	72	62	.309	.505	.489	.501
24	29.439	29.399	29.380	29.406	65	68	66	67	80	72	73.0	83	58	.591	.524	.559	.558
25	29.436	29.459	29.464	29.453	68	69	62	72	80	69	73.7	82	64	.631	.561	.462	.551
26	29.492	29.477	29.423	29.464	64	70	68	66	80	74	73.3	82	58	.569	.598	.604	.590
27	29.436	29.396	29.336	29.389	70	73	69	73	82	72	75.7	83	69	.693	.690	.668	.684
28	29.324	29.283	29.148	29.252	69	65	65	73	70	69	70.7	84	62	.655	.550	.564	.570
29	29.286	29.221	29.215	29.241	63	70	66	65	80	74	73.0	83	61	.549	.598	.532	.560
30	29.325	29.305	29.339	29.323	63	68	57	68	77	64	69.7	78	62	.509	.564	.373	.482
31	29.444	29.385	29.249	29.359	58	64	65	65	77	71	71.0	80	52	.389	.422	.537	.449
Means....	29.438	29.420	29.380	29.413	....	....	....	69.4	76.4	70.4	72.1	....	....	.575	.573	.567	.571
Aug. 1	29.137	29.135	29.171	29.148	67	67	59	70	81	67	72.7	82	65	.622	.474	.393	.496
2	29.274	29.335	29.388	29.332	54	60	55	60	72	62	64.7	76	56	.338	.358	.340	.345
3	29.472	29.417	29.318	29.402	60	63	61	69	74	66	69.7	77	51	.398	.429	.430	.432
4	29.346	29.435	29.497	29.426	56	60	53	59	70	58	63.3	73	56	409	.385	.336	.377
5	29.556	29.537	29.598	29.564	55	58	57	60	74	61	65.0	75	50	367	.270	.412	.350
6	29.581	29.550	29.500	29.544	52	62	58	58	76	63	65.7	76	49	.309	.369	.416	.365
7	29.528	29.492	29.449	29.490	59	61	60	63	69	64	65.3	74	59	.447	.430	.465	.447
8	29.364	29.209	28.986	29.186	60	64	67	63	68	69	66.7	68	60	.478	.543	.635	.552
9	29.328	29.384	29.351	29.354	56	59	60	59	69	64	64.0	74	56	.409	.367	.465	.414
10	29.492	29.484	29.469	29.482	58	63	62	63	69	67	66.3	72	54	.416	.495	.489	.467
11	29.541	29.552	29.496	29.530	64	65	64	67	69	66	67.3	71	60	.556	.564	.569	.563
12	29.400	29.330	29.343	29.358	64	67	68	65	72	71	69.3	74	63	.583	.595	.644	.607
13	29.229	29.252	29.341	29.274	69	68	66	70	76	68	71.3	81	67	.695	.577	.612	.628
14	29.356	29.356	29.363	29.358	61	69	64	63	78	67	69.3	80	62	.510	.588	.556	.551
15	29.556	29.654	29.670	29.627	59	55	47	62	61	50	51.0	70	49	.460	.354	.283	.366
16	29.727	29.704	29.644	29.692	48	54	56	52	65	60	59.0	66	42	.282	.272	.396	.317
17	29.655	29.587	29.506	29.583	50	60	55	52	74	62	62.7	75	44	.334	.331	.340	.335
18	29.477	29.404	29.303	29.395	60	64	63	64	75	68	69.0	76	51	.465	.449	.509	.508
19	29.296	29.262	29.318	29.290	58	60	64	62	69	56	62.3	72	55	.429	.398	.391	.406
20	29.401	29.312	29.303	29.339	51	58	55	52	72	58	60.7	74	45	.361	.296	.393	.350
21	29.311	29.277	29.195	29.261	53	56	55	55	67	60	60.7	71	49	.376	.303	.367	.349
22	29.305	29.334	29.338	29.326	48	52	47	52	62	50	54.7	72	50	.282	.256	.283	.274
23	29.314	29.286	29.305	29.302	45	49	47	48	57	49	51.3	69	45	.260	.242	.297	.366
24	29.402	29.395	29.381	29.393	48	52	48	50	61	54	55.0	62	47	.309	.269	.256	.278
25	29.491	29.454	29.391	29.445	45	54	48	48	63	54	55.0	65	41	.260	.298	.256	.271
26	29.376	29.339	29.296	29.337	52	60	50	59	70	62	63.7	72	49	.296	.385	.202	.294
27	29.292	29.288	29.272	29.284	55	61	60	60	72	65	65.7	76	55	.367	.390	.451	.369
28	29.308	29.293	29.306	29.302	58	66	60	60	74	63	65.7	79	49	.456	.532	.478	.489
29	29.405	29.396	29.361	29.387	55	60	59	58	69	64	63.7	69	56	.393	.398	.433	.408
30	29.343	29.310	29.250	29.301	59	64	62	61	69	65	65.0	67	60	.473	.529	.516	.506
31	29.298	29.218	29.213	29.243	63	66	64	65	72	68	68.3	75	62	.549	.559	.543	.550
Means....	29.405	29.390	29.365	29.386	....	....	....	59.6	70.5	62.0	64.0	....	....	.416	.410	.427	.418

the northern and northwestern lakes at Detroit, Michigan.

VAPOR.				WIND.								Amount of cloudiness. (0=clear sky.) (10=sky entirely overcast.)			Amount of evaporation, in U. S. inches and decimals.	Amount of rain or melted snow, in U. S. inches and decimals.
Humidity. Saturation=1,000.				Direction. From whence.			Velocity, in miles, per hour.			Resultant velocity, in miles, per hour.	Resultant direction					
7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.		°	7 a. m.	2 p. m.	9 p. m.		
.831	.545	.440	.605	SE	SW	SE	1.5	7.0	10.5	4.7	S. 15 E.	8	9	10	......	......
.735	.531	.663	.643	SW	S. SW	S. SW	5.7	10.0	4.3	6.7	S. 28 W.	8	8	8	......	.04
.695	.472	.723	.630	SW	W	S	7.0	8.5	7.0	6.0	S. 49 W.	9	10	10	......	......
.831	.603	.658	.697	W	W	W	5.0	5.0	2.5	4.2	West	10	7	8	......	.60
.570	.569	.724	.621	SW	SW	SW	4.5	5.0	1.8	3.7	S. 45 W.	6	8	6	......	......
.731	.535	.716	.661	SW	SW	SW	3.8	9.3	6.8	6.3	S. 45 W.	4	2	4	......	......
.850	.636	.899	.795	SW	SW	SW	5.7	4.4	8.5	6.3	S. 45 W.	9	8	10	......	.52
.899	.720	.527	.715	W	E	NE	1.8	6.5	3.5	2.7	N. 73 E.	10	9	9	......	.92
.822	.532	.713	.689	NE	E	NE	2.0	7.0	1.5	3.3	N. 76 E.	8	3	4	......	......
.825	.562	.786	.731	NE	E. NE	S	4.5	5.2	0.5	3.0	N. 60 E.	0	2	3	......	......
.833	.537	.704	.691	S	S. SW	S. SW	3.0	3.8	2.5	3.0	S. 15 W.	2	3	5	......	......
.799	.535	.812	.715	W	SW	SW	2.0	4.5	1.0	2.3	S. 56 W.	0	0	3	......	......
.768	.472	.741	.660	W	W	W	3.0	5.0	1.5	3.2	West	0	7	7	......	......
.731	.448	.738	.639	W	W	SW	2.6	3.8	1.0	2.3	S. 84 W.	6	5	4	......	......
.693	.472	.704	.623	SW	SW	SW	3.0	6.7	2.0	4.0	S. 45 W.	0	4	5	......	......
.704	.477	.741	.641	SW	W.SW.	W.SW.	2.0	6.8	2.8	4.0	S. 65 W.	3	6	7	......	......
.738	.774	.854	.789	SW	SW	SW	3.3	6.8	1.3	3.3	S. 45 W.	0	9	8	......	......
.950	.793	.780	.841	SW	N.NW.	N	5.0	6.5	3.5	3.0	N. 41 E.	10	10	8	......	.34
.833	.751	.836	.807	N. NE	E. NE	E. SE	3.8	2.5	0.3	2.0	N. 41 E.	7	8	6	......	.10
.786	.704	.740	.743	E. NE	E. NE	SE	2.8	5.0	3.0	3.0	N. 85 E.	8	8	10	......	......
.895	.648	.793	.779	SW	N	NW	2.3	3.7	1.0	1.3	N. 45 W.	8	8	9	......	.02
.848	.627	.758	.744	S	SW	W.NW.	2.0	5.5	3.0	2.7	S. 54 W.	4	4	6	......	......
.743	.563	.740	.682	NE	E. NE	NE	2.3	6.2	2.7	3.7	N. 59 E.	4	4	6	......	......
.893	.512	.712	.706	N. NE	SW	S	1.0	3.5	2.8	1.7	S. 25 W.	0	5	7	......	......
.804	.548	.653	.668	N. NW.	E	NE	6.0	6.4	2.0	2.7	N. 43 E.	4	5	4	......	......
.891	.585	.720	.732	N. NW.	NE	SE	0.5	4.5	4.5	2.0	N. 86 E	3	2	8	......	......
.854	.632	.852	.779	S. SE	E	SW	2.0	4.0	1.5	1.3	S. 52 E.	4	8	4	......	......
.807	.751	.796	.785	NE	NW	NW	0.7	3.0	1.3	1.3	N. 40 W.	3	7	4	......	......
.890	.585	.634	.703	NW	N. NE	E	2.5	3.3	2.5	1.7	N. 24 E.	8	6	8	......	......
.743	.608	.625	.659	N	N. NE	N. NW.	5.0	6.5	5.3	5.0	N. 2 E.	6	7	7	......	......
.631	.456	.708	.598	N	SW	S. SE	4.3	3.3	9.0	2.3	S. 9 E.	6	7	8	......	.40
.794	.587	.725	.702	....	....	....	....	....	....	1.1	S. 46 W.	5.1	6.1	6.6	......	2.94
.848	.448	.595	.630	SW	W	W	6.8	8.0	2.0	5.0	S. 19 W.	10	4	0	......	......
.653	.457	.612	.574	NW	NW	NW	7.7	9.0	1.5	6.0	N. 45 W.	7	6	4	......	......
.564	.511	.735	.603	W.SW.	SW	NW	3.5	4.0	4.8	3.0	S. 85 W.	3	10	10	......	......
.819	.525	.698	.681	N	N	N	8.0	11.0	2.0	7.0	North	8	6	4	......	.66
.708	.322	.769	.600	NW	NW	NW	11.5	8.5	1.0	7.0	N. 45 W.	2	5	5	......	......
.641	.412	.723	.592	NW	W	W	7.2	8.7	0.7	5.0	N. 70 W.	3	6	7	......	......
.776	.607	.780	.721	SW	SW	SW	1.8	6.0	0.3	2.7	S. 45 W.	8	9	10	......	......
.831	.793	.896	.840	E. SE	SE	NE	5.8	11.0	4.8	6.0	S. 69 E.	10	10	10	......	......
.819	.518	.780	.706	N. NW.	NW	W	9.7	10.0	2.3	7.0	N. 41 W.	10	6	4	......	.60
.723	.700	.740	.721	N	E	E. SE	4.8	6.5	2.0	4.0	N. 78 E.	8	9	9	......	......
.841	.796	.891	.843	SE	W.SW.	SW	2.3	2.5	2.0	1.3	S. 32 W.	9	10	10	......	......
.944	.758	.850	.851	S. SE	S	S. SW.	11.5	8.0	4.0	7.7	S. 7 E.	10	10	10	......	.52
.948	.644	.895	.829	SW	W.NW.	NW	2.7	3.3	2.0	2.0	N. 83 W.	10	9	10	......	.07
.886	.613	.841	.780	N	SW	N	7.0	4.0	3.0	2.7	N. 21 W.	9	4	7	......	......
.828	.659	.786	.758	N	N	N	7.3	8.7	4.8	6.9	North	10	9	5	......	.20
.727	.441	.765	.644	N	E. NE	SE	6.0	6.0	5.5	3.3	N. 65 E.	0	3	3	......	......
.861	.395	.612	.623	W.NW.	SW	S	1.0	4.5	1.5	2.0	S. 42 W.	0	3	4	......	......
.780	.518	.743	.680	SW	W	W.NW.	2.0	2.8	0.3	1.7	S. 75 W.	5	9	10	......	......
.772	.564	.872	.739	N	N	N	8.0	10.0	2.8	6.9	North	8	5	9	......	......
.930	.378	.816	.708	N	W.SW.	S. SW	1.0	5.0	12.0	5.0	S. 39 W.	4	4	10	......	......
.869	.459	.708	.679	W.NW.	W.NW.	N. NW.	4.0	5.5	2.0	3.7	N. 60 W.	6	4	10	......	.24
.727	.461	.786	.658	NW	NW	NW	11.0	3.5	3.8	16.7	N. 45 W.	3	9	5	......	......
.777	.521	.853	.717	NW	NW	NW	7.5	5.3	1.0	20.7	N. 45 W.	3	7	7	......	......
.836	.502	.613	.657	NW	NW	NW	4.0	6.8	2.0	9.0	N. 45 W.	9	5	8	......	......
.777	.519	.613	.636	W	NW	NW	2.4	8.5	1.2	4.0	N. 56 W.	2	8	3	......	......
.592	.525	.364	.494	SW	SW	SW	5.3	5.0	2.5	4.0	S. 45 W.	6	7	10	......	......
.708	.497	.731	.645	SW	S. SW	W.NW.	5.8	6.7	0.3	4.0	S. 33 W.	6	8	9	......	......
.280	.634	.831	.782	S	E. NE	W	1.5	3.5	0.5	1.0	S. 79 E.	4	5	10	......	......
.816	.564	.727	.702	N	E. NE	E	5.0	5.0	1.5	3.0	N. 43 E.	9	4	10	......	.04
.882	.747	.836	.822	SW	SW	NE	2.8	4.0	1.5	1.7	S. 45 W.	10	10	10	......	.04
.890	.712	.793	.798	E	E. SE	E. NE	4.5	5.0	4.7	4.3	S. 89 E.	10	10	10	......	.14
.796	.555	.750	.700	....	....	....	....	....	....	2.5	N. 51 W.	6.5	6.9	7.5	......	2.51

Reductions of the monthly meteorological register of the survey of

Date.	Barometer reduced to temperature of 32° Fahr., expressed in United States inches and decimals.				Temperature—Fahrenheit.									Vapor.			
					Wet bulb, or point of evaporation.			Dry bulb, or temperature of the open air.				Maximum.	Minimum.	Elasticity, in U. S. inches and decimals.			
	7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	Mean.			7 a. m.	2 p. m.	9 p. m.	Mean.
1866.					°	°	°	°	°	°	°	°	°				
Sept. 1	29.170	29.119	29.136	29.142	67	70	66	69	83	69	73.7	82	66	.635	.558	.599	.597
2	29.169	29.260	29.366	29.265	68	62	61	71	79	66	72.0	79	65	.644	.329	.470	.481
3	29.450	29.427	29.446	29.441	60	62	56	63	71	60	64.7	72	58	.478	.436	.396	.437
4	29.425	29.243	29.207	29.292	59	65	66	61	70	68	66.3	73	52	.473	.550	.612	.545
5	29.365	29.399	29.498	29.421	57	57	54	61	69	60	63.3	70	58	.412	.306	.338	.352
6	29.511	29.461	29.440	29.471	51	62	56	55	76	63	64.7	76	47	.321	.369	.356	.382
7	29.366	29.264	29.220	29.283	55	55	55	57	59	57	57.7	66	55	.407	.380	.407	.398
8	29.382	29.418	29.519	29.440	53	56	52	56	66	55	59.0	70	54	.363	.316	.349	.343
9	29.699	29.662	29.615	29.659	47	59	52	49	65	55	56.3	68	45	.297	.420	.349	.355
10	29.602	29.484	29.331	29.472	54	61	59	58	68	61	62.3	71	46	.365	.443	.473	.427
11	29.127	29.013	29.001	29.047	63	68	58	65	70	63	66.0	71	60	.549	.658	.416	.541
12	29.090	29.062	29.180	29.111	59	59	51	62	72	57	63.7	71	56	.460	.340	.295	.365
13	29.376	29.408	29.389	29.391	49	55	50	53	62	54	56.3	65	49	.295	.340	.308	.314
14	29.343	29.328	29.538	29.403	50	52	41	52	63	46	53.7	65	45	.334	.243	.192	.256
15	29.756	29.729	29.655	29.713	38	45	45	40	53	49	47.3	55	34	.203	.194	.247	.215
16	29.539	29.446	29.272	29.419	52	55	65	54	57	66	59.0	66	48	.362	.407	.604	.458
17	29.445	29.443	29.405	29.431	50	53	49	52	57	51	53.3	69	48	.334	.350	.321	.335
18	29.379	29.337	29.305	29.340	45	46	47	48	49	49	48.7	54	45	.260	.271	.297	.276
19	29.343	29.415	29.437	29.398	46	49	45	48	51	48	50.0	54	46	.284	.282	.260	.275
20	29.359	29.204	29.182	29.248	47	45	47	49	48	48	48.3	50	45	.297	.260	.310	.289
21	29.442	29.500	29.522	29.488	41	46	44	44	50	46	46.7	52	44	.218	.258	.262	.246
22	29.614	29.598	29.555	29.589	37	46	45	38	53	48	46.3	55	34	.207	.219	.260	.229
23	29.542	29.507	29.463	29.504	45	47	52	48	61	54	54.3	61	45	.260	.125	.362	.249
24	29.416	29.401	29.419	29.412	54	58	59	58	61	61	60.0	59	50	.365	.443	.473	.427
25	29.469	29.422	29.498	29.463	54	51	45	55	54	46	51.7	61	44	.404	.335	.286	.342
26	29.626	29.596	29.515	29.589	43	52	48	44	62	51	52.3	65	40	.264	.256	.296	.272
27	29.636	29.619	29.597	29.617	47	60	52	50	69	54	57.7	71	44	.283	.398	.362	.348
28	29.695	29.628	29.609	29.644	45	61	51	46	71	53	56.7	73	42	.286	.403	.348	.346
29	29.665	29.625	29.600	29.630	49	58	52	59	67	53	56.7	68	43	.335	.363	.375	.358
30	29.619	29.587	29.576	29.594	49	61	54	59	67	57	58.0	68	45	.335	.457	.378	.390
Means....	29.454	29.420	29.417	29.430	....	....	....	53.5	63.5	55.6	57.5	....	....	.358	.357	.367	.361
Oct. 1	29.614	29.544	29.459	29.539	46	62	57	47	68	58	47.7	69	43	.297	.476	.452	.408
2	29.420	29.327	29.388	29.378	52	64	52	54	76	57	62.3	77	51	.362	.436	.322	.373
3	29.534	29.487	29.492	29.504	41	48	42	44	54	44	47.3	60	40	.218	.256	.241	.238
4	29.664	29.700	29.778	29.714	43	47	38	45	53	40	46.0	53	39	.251	.244	.203	.233
5	29.890	29.853	29.850	29.864	43	44	41	46	54	45	48.3	56	34	.238	.157	.205	.200
6	29.815	29.744	29.681	29.747	36	55	49	37	63	52	50.7	66	32	.199	.327	.308	.278
7	29.704	29.641	29.564	29.636	50	63	57	56	74	60	63.3	75	47	.282	.429	.426	.379
8	29.544	29.463	29.368	29.458	55	61	58	56	74	61	63.7	74	52	.420	.363	.443	.412
9	29.366	29.328	29.244	29.313	50	58	54	56	65	56	59.0	64	55	.282	.389	.391	.354
10	29.284	29.365	29.412	29.354	55	57	55	56	61	57	58.0	60	53	.420	.412	.407	.413
11	29.465	29.463	29.416	29.448	54	50	54	55	58	57	56.7	59	52	.404	.255	.378	.346
12	29.451	29.434	29.411	29.432	53	55	52	55	62	55	57.3	62	53	.376	.340	.349	.355
13	29.539	29.569	29.597	29.568	48	54	51	49	58	55	54.0	60	45	.322	.365	.321	.336
14	29.716	29.730	29.789	29.745	45	53	47	47	61	49	52.3	60	46	.273	.297	.297	.289
15	29.900	29.875	29.872	29.882	44	52	45	45	62	48	51.7	62	41	.275	.256	.260	.264
16	29.979	29.807	29.699	29.828	41	57	49	42	70	52	54.7	71	40	.244	.293	.308	.282
17	29.640	29.532	29.505	29.559	40	57	50	42	71	53	55.3	72	40	.221	.280	.321	.274
18	29.525	29.434	29.374	29.444	42	58	53	44	72	63	59.7	73	40	.241	.296	.270	.269
19	29.414	29.434	29.464	29.437	51	57	56	57	65	60	60.7	67	55	.295	.359	.396	.350
20	29.541	29.485	29.402	29.476	56	61	59	58	70	66	64.7	71	56	.422	.416	.407	.415
21	29.304	29.174	29.014	29.164	58	59	57	64	66	65	65.0	69	62	.403	.407	.359	.390
22	29.064	29.190	29.271	29.175	45	45	40	48	59	48	51.7	68	47	.260	.247	.143	.217
23	29.256	29.298	29.332	29.289	35	38	32	41	43	34	39.3	51	32	.126	.164	.155	.148
24	29.453	29.476	29.528	29.486	31	33	33	34	38	35	35.7	39	31	.137	.123	.162	.141
25	29.616	29.546	29.449	29.537	31	38	38	35	44	41	40.0	45	33	.128	.151	.190	.156
26	29.304	29.284	29.397	29.328	38	40	36	40	42	39	40.3	46	38	.203	.221	.173	.199
27	29.557	29.608	29.607	29.591	34	40	37	36	44	38	39.3	44	34	.170	.195	.207	.191
28	29.472	29.280	29.238	29.330	43	49	31	46	57	38	47.0	59	38	.238	.242	.093	.191
29	29.299	29.254	29.221	29.258	39	40	39	42	44	42	42.7	56	40	.199	.195	.199	.198
30	29.174	29.187	29.328	29.230	38	38	34	40	44	37	40.3	46	36	.203	.151	.157	.170
31	29.525	29.565	29.533	29.541	31	32	33	31	37	36	34.7	39	29	.174	.116	.149	.146
Means....	29.517	29.486	29.474	29.492	....	....	....	46.7	58.3	49.7	51.6	....	....	.267	.289	.280	.279

the northern and northwestern lakes at Detroit, Michigan.

VAPOR.				WIND.								Amount of cloudiness. (0=clear sky.) (10=sky entirely overcast.)			Amount of evaporation, in U. S. inches and decimals.	Amount of rain or melted snow, in U. S. inches and decimals.
Humidity. Saturation = 1,000.				Direction. From whence.			Velocity, in miles, per hour.			Resultant velocity, in miles, per hour.	Resultant direction.					
7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.			7 a. m.	2 p. m.	9 p. m.		
.896	.495	.846	.746	S	S. SW	N	4.5	11.3	5.0	3.7	° S. 26 W.	5	6	10	......	.06
.850	.332	.735	.639	SW	W	W	4.8	6.0	0.3	3.3	S. 71 W.	8	6	10	......	......
.831	.576	.765	.724	SE	E	NE	0.3	4.0	1.0	1.7	N. 81 E.	9	7	0	......	......
.882	.751	.895	.843	NE	SE	S	5.5	12.5	2.0	6.3	S. 47 E.	8	10	5	......	......
.769	.432	.653	.618	W.NW.	W.NW.	W	9.5	8.3	1.3	6.3	N. 70 W.	4	8	3	......	......
.743	.412	.619	.591	W	E	SE	1.7	5.5	3.3	2.3	S. 71 E.	3	7	9	......	......
.874	.761	.874	.836	NE	N	N. NE.	4.5	5.3	5.5	4.7	N. 21 E.	10	10	10	......	.54
.809	.495	.805	.703	W	W.NW.	W	4.0	5.0	2.3	3.7	N. 80 W.	10	7	5	......	.42
.853	.680	.805	.779	NW	E. NE.	E. NE.	7.0	3.5	2.0	2.3	N. 7 E.	8	7	6	......	.10
.756	.647	.882	.762	E. NE.	E	E. NE.	1.8	5.0	7.5	4.7	N. 76 E.	8	7	10	......	......
.890	.898	.723	.837	E. SE.	SW	SW	1.8	4.0	6.0	3.0	S. 37 W.	10	10	10	......	.22
.828	.449	.634	.637	SW	W	W	8.0	10.0	3.5	6.7	S. 73 W.	10	5	6	......	.18
.733	.612	.738	.694	W	W	W	4.3	4.6	2.3	3.7	West	7	10	10	......	......
.861	.422	.617	.633	SW	W.SW.	NW	2.2	9.0	4.7	4.7	S. 84 W.	3	5	6	......	......
.820	.483	.710	.671	NW	E	SE	1.3	4.7	4.8	2.7	S. 70 E.	0	6	10	......	......
.867	.874	.945	.895	N	SW	S. SE.	1.3	2.3	13.0	4.3	S. 16 E.	10	10	10	......	.08
.861	.752	.839	.824	N. NW.	E	E	9.3	4.8	3.3	3.3	N. 27 E.	10	10	10	......	.60
.777	.781	.853	.804	NE	NE	NE	6.0	5.5	5.0	5.3	N. 45 E.	10	10	10	......	.26
.850	.674	.777	.767	N	N	N	7.0	11.4	5.7	8.0	North	10	10	8	......	.30
.853	.777	.925	.852	NE	NE	N.NW.	5.0	5.5	8.8	5.3	N. 15 E.	10	10	10	......	.16
.756	.716	.843	.772	NW	NW	NW	5.5	7.0	1.0	4.7	N. 4 W.	10	6	9	......	.26
.905	.544	.777	.742	NW	E. NE.	E. NE.	3.0	4.8	5.0	2.3	S. 77 E.	0	5	4	......	......
.777	.224	.867	.623	SE	SE	SE	5.0	5.5	5.5	5.3	S. 45 E.	4	6	7	......	......
.756	.825	.882	.821	SE	S. SW.	S. SW.	16.7	11.5	4.5	9.0	S. 12 E.	7	9	10	......	......
.934	.802	.921	.886	NE	N. NW.	N. NE.	3.5	11.0	3.7	5.3	N. 5 W.	10	10	10	......	.32
.918	.461	.790	.723	N	W.SW.	W	3.0	2.4	1.3	2.0	N. 36 W.	3	3	4	......	.84
.786	.564	.867	.739	W.SW.	S	E. SE.	3.4	3.3	1.0	1.7	S. 26 W.	0	0	0	......	......
.921	.532	.864	.772	SE	SE	SW	2.0	4.5	0.3	2.0	S. 43 E.	0	0	7	......	......
.927	.550	.932	.803	E	E	E	0.5	5.3	1.0	2.3	East	6	6	0	......	......
.927	.690	.812	.810	E	E	E	3.7	3.0	2.0	2.9	East	7	8	8	......	......
.840	.607	.807	.751	....	....	....	....	....	....	0.2	N. 34 E.	6.7	7.1	7.2	......	4.34
.923	.695	.937	.852	NE	SW	SW	2.0	3.0	1.0	0.7	S. 45 W.	3	8	7	......	......
.867	.486	.692	.682	SW	SW	E. NE.	3.0	4.5	3.5	1.3	S. 30 W.	8	6	10	......	......
.756	.613	.836	.735	N. NW.	E	NE	8.5	6.7	4.7	4.3	N. 31 E.	9	4	8	......	......
.840	.606	.820	.755	NE	NE	NE	5.0	8.0	6.3	6.3	N. 45 E.	7	6	5	......	......
.767	.376	.684	.612	SE	E	SE	9.0	10.5	2.7	6.7	S. 66 E.	7	2	4	......	......
.903	.568	.794	.755	SE	SE	SE	2.0	3.5	0.3	2.0	S. 45 E.	3	0	5	......	......
.627	.511	.822	.653	SW	SW	SW	2.0	6.0	1.3	3.0	S. 45 W.	8	4	5	......	......
.935	.433	.825	.731	SW	S. SW.	E. SE.	2.0	9.0	8.0	4.3	S. 11 E.	0	4	7	......	......
.627	.631	.872	.710	E. SE.	S. SW.	S. SW.	0.3	3.5	4.0	2.7	S. 19 W.	9	10	10	......	.10
.935	.769	.874	.859	E	E	E	1.3	5.5	2.7	3.2	East	10	9	8	......	.54
.934	.529	.812	.758	N. NE.	N	NE	5.7	6.6	4.8	5.3	N. 20 E.	10	10	10	......	......
.869	.612	.805	.762	NE	NE	NE	3.5	2.7	1.7	2.7	N. 45 E.	10	9	8	......	......
.926	.756	.743	.808	NE	NE	NE	5.0	7.7	2.3	5.0	N. 45 E.	8	10	10	......	......
.847	.553	.853	.751	N	NE	NE	6.0	4.7	2.0	3.7	N. 25 E.	3	0	0	......	......
.920	.461	.777	.719	N	E	N	5.7	4.5	2.0	3.0	N. 31 E.	0	0	0	......	......
.914	.400	.794	.703	N	N. NW.	NW	0.3	2.0	0.3	1.0	N. 17 W.	0	0	6	......	......
.829	.369	.798	.665	NW	W	W	0.3	3.0	1.0	1.3	N. 87 W.	0	3	5	......	......
.836	.378	.470	.561	S	S. SW.	S. SW.	0.3	7.0	10.5	6.0	S. 21 W.	4	3	10	......	.24
.634	.582	.765	.660	S. SW.	S. SW.	W.NW.	4.3	2.4	2.0	2.3	S. 39 W.	9	10	10	......	.06
.876	.570	.636	.694	SW	SW	SW	3.5	6.7	8.3	6.0	S. 45 W.	9	7	10	......	......
.675	.636	.582	.631	S	SW	S	12.5	10.0	12.0	10.7	S. 14 W.	10	10	10	......	......
.777	.710	.426	.638	SW	SW	SW	13.0	11.0	5.7	9.7	S. 45 W.	10	2	0	......	......
.488	.587	.792	.622	W.SW.	W	W.SW.	10.0	9.5	6.0	8.3	S. 76 W.	0	7	8	......	......
.712	.537	.797	.682	N	N. NW.	N. NW.	2.0	10.0	0.3	3.7	N. 31 W.	4	9	8	......	.26
.628	.522	.738	.629	NE	SE	SE	2.7	5.0	8.7	4.7	S. 56 E.	8	8	10	......	......
.820	.829	.726	.825	S. SW.	W	W	8.0	8.7	6.5	6.7	S. 69 W.	10	10	10	......	.52
.802	.677	.905	.795	W	W	SE	5.5	1.4	6.5	1.7	S. 27 W.	10	10	10	......	.28
.767	.521	.408	.565	SE	S	SW	5.7	9.7	4.0	5.7	S. 5 E.	10	10	10	......	......
.744	.677	.744	.722	W.NW.	NW	W.NW.	3.0	4.7	2.0	3.0	N. 55 W.	7	8	10	......	......
.820	.522	.712	.685	SW	W	NW	6.0	7.0	10.0	6.3	N. 83 W.	10	10	10	......	......
1.000	.527	.705	.744	W.NW.	W.NW.	SW	3.0	6.0	4.7	3.7	N. 89 W.	5	8	10	......	......
.806	.569	.747	.707	....	....	....	....	....	....	1.1	S. 37 W.	6.5	6.3	7.6	......	2 00

Reductions of the monthly meteorological register of the survey of

Date.	Barometer reduced to temperature of 32° Fahr., expressed in United States inches and decimals.				TEMPERATURE—FAHRENHEIT.									VAPOR.			
					Wet bulb, or point of evaporation.			Dry bulb, or temperature of the open air.				Maximum.	Minimum.	Elasticity, in U. S. inches and decimals.			
	7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	Mean.			7 a. m.	2 p. m.	9 p. m.	Mean.
1866.					°	°	°	°	°	°	°	°	°				
Nov. 1	29.357	29.211	29.178	29.249	35	42	44	39	51	49	46.3	55	35	.152	.149	.223	.175
2	29.480	29.541	29.652	29.558	33	43	35	35	50	38	41.0	51	34	.162	.186	.165	.171
3	29.741	29.734	29.746	29.740	29	35	34	30	40	38	36.0	40	28	.149	.139	.144	.144
4	29.837	29.888	29.958	29.894	36	36	32	40	40	34	38.0	40	33	.160	.160	.155	.158
5	30.071	30.099	30.063	30.078	28	35	28	30	38	30	32.7	39	28	.130	.165	.130	.142
6	30.069	29.910	29.833	29.917	29	40	30	25	49	33	35.7	51	21	....	.130	.132	.131
7	29.723	29.601	29.541	29.622	27	47	34	28	56	36	40.0	58	24	.136	.204	.170	.170
8	29.492	29.453	29.488	29.478	38	49	45	41	55	46	47.3	56	33	.190	.269	.286	.248
9	29 603	29.508	29.525	29.545	44	52	42	45	60	46	50.3	61	44	.275	.282	.215	.257
10	29.543	29.417	29.013	29.324	29	42	44	30	45	46	40.3	49	29	.149	.228	.262	.213
11	29.084	29.215	29.425	29.241	39	40	36	41	44	39	41.3	51	37	.212	.195	.173	.193
12	29.574	29.613	29.687	29.625	35	42	31	38	48	33	39.7	49	32	.165	.189	.151	.168
13	29.746	29.760	29.552	29.686	28	41	40	30	47	42	39.7	47	28	.130	.179	.221	.177
14	29.378	29.332	29.294	29.335	40	45	45	46	46	47	46.3	50	41	.169	.286	.273	.243
15	29.163	28.976	28.941	29.027	38	41	36	39	43	37	39.7	50	36	.216	.231	.199	.215
16	28.874	28.929	29.045	28.949	33	35	36	34	39	39	37.3	39	32	.175	.152	.173	.167
17	29.224	29.336	29.260	29.273	34	39	37	35	44	38	39.0	48	34	.183	.173	.207	.188
18	29.326	29.286	29.252	29.288	38	42	42	40	46	43	43.0	47	37	.203	.215	.254	.224
19	29.065	28.907	28.962	28.978	43	43	39	44	45	41	43.3	45	39	.264	.251	.212	.242
20	29.117	29.197	29.278	29.197	38	38	33	40	40	33	37.7	44	31	.203	.203	.168	.225
21	29.401	29.346	29.299	29.349	29	29	30	31	31	32	31.3	37	29	.137	.137	.144	.139
22	29.004	29.115	29.328	29.149	34	30	31	35	30	32	32.3	35	29	.183	.167	.162	.171
23	29.457	29.471	29.490	29.473	30	30	31	20	30	29	26.3	34	19	....	.167	....	.167
24	29.585	29.538	29.533	29.552	29	31	31	21	32	30	27.7	33	20	....	.162	....	.162
25	29.639	29.590	29.533	29.587	31	31	31	26	37	33	32.0	40	25	....	.105	.151	.128
26	29.497	29.434	29.430	29.451	30	36	40	32	40	43	38.3	43	31	.144	160	.208	.171
27	29.406	29.309	29.237	29.317	36	46	46	40	52	48	46.7	52	38	.160	.232	.284	.225
28	29.146	29.041	29.153	29.113	49	49	38	51	50	40	47.9	51	38	.321	.335	.203	.286
29	29.173	29.180	29.190	29.181	32	33	32	34	35	34	34.3	43	32	.155	.162	.155	.157
30	29.253	29.306	29.455	29.338	31	31	31	29	31	30	30.0	38	27	.174	....	....	.174
Means....	29.439	29.408	29.411	29.419	....	....	....	35.0	43.1	38.0	38.7	....	....	.181	.194	.193	.187
Dec. 1	29.600	29.591	29.577	29.589	....	....	....	29	31	30	30.0	34	28	....	....	....	....
2	29.576	29.492	29.464	29.511	....	....	....	28	41	38	35.7	41	26	....	....	....	....
3	29.336	29.162	29.104	29.201	....	....	....	43	45	45	44.3	47	35	....	....	....	....
4	29.056	29.164	29.344	29.188	....	....	....	41	42	35	39.3	49	34	....	....	....	....
5	29.555	29.619	29.639	29.604	....	....	....	30	42	39	37.0	43	29	....	....	....	....
6	29.523	29.454	29.436	29.471	....	....	....	39	44	44	42.3	46	37	....	....	....	....
7	29.507	29.368	29.188	29.354	....	....	....	40	45	42	42.3	47	38	....	....	....	....
8	28.765	28.788	28.995	28.846	....	....	....	52	46	31	43.0	54	30	....	....	....	....
9	29.205	29.108	29.279	29.197	....	....	....	24	23	14	20.3	33	13	....	....	....	....
10	29.321	29.399	29.412	29.377	....	....	....	11	20	14	15.0	19	10	....	....	....	....
11	29.385	29.371	29.436	29.397	....	....	....	18	21	14	17.7	20	12	....	....	....	....
12	29.530	29.577	29.593	29.567	....	....	....	15	18	16	16.3	18	13	....	....	....	....
13	29.645	29.566	29.553	29.588	....	....	....	16	20	18	18.0	22	13	....	....	....	....
14	29.777	29.825	29.864	29.822	....	....	....	12	22	20	18.0	23	10	....	....	....	....
15	29.826	29.673	29.426	29.642	....	....	....	14	21	20	18.3	23	12	....	....	....	....
16	29.059	28.662	29.109	28.943	....	....	....	24	30	27	27.0	28	14	....	....	....	....
17	29.246	29.387	29.538	29.390	....	....	....	23	26	20	23.0	30	16	....	....	....	....
18	29.633	29.518	29.453	29.535	....	....	....	19	23	28	23.3	29	16	....	....	....	....
19	29.471	29.470	29.611	29.517	....	....	....	30	34	25	29.7	35	24	....	....	....	....
20	29.936	29.913	29.880	29.910	....	....	....	10	8	11	69.7	29	7	....	....	....	....
21	29.791	29.555	29.519	29.622	....	....	....	16	24	26	22.0	26	6	....	....	....	....
22	29.354	29.177	29.051	29.194	....	....	....	35	37	36	36.0	38	24	....	....	....	....
23	28.832	28.636	28.757	28.742	....	....	....	40	39	38	39.0	41	35	....	....	....	....
24	28.949	28.981	29.004	28.978	....	....	....	31	31	29	30.3	40	27	....	....	....	....
25	29.231	29.255	29.281	29.256	....	....	....	21	22	18	20.3	31	12	....	....	....	....
26	29.273	29.139	29.150	29.187	....	....	....	25	29	20	24.7	30	17	....	....	....	....
27	29.263	29.342	29.448	29.351	....	....	....	14	17	13	14.7	24	11	....	....	....	....
28	29.459	29.487	29.541	29.496	....	....	....	10	19	15	14.7	19	8	....	....	....	....
29	29.635	29.569	29.575	29.593	....	....	....	18	18	16	17.3	19	8	....	....	....	....
30	29.622	29.570	25.552	29.581	....	....	....	13	19	14	15.3	21	12	....	....	....	....
31	29.471	29.416	29.535	29.474	....	....	....	16	22	22	20.0	25	12	....	....	....	....
Means....	29.414	29.362	29.397	29.391	....	....	....	24.4	28.3	25.1	25.9	....	....	....	....	....	....

the northern and northwestern lakes at Detroit, Michigan.

VAPOR.				WIND.								Amount of cloudiness. (0 = clear sky.) (10 = sky entirely overcast.)			Amount of evaporation, in U. S. inches and decimals.	Amount of rain or melted snow, in U. S. inches and decimals.
Humidity. Saturation = 1,000.				Direction. From whence.			Velocity, in miles, per per hour.			Resultant velocity, in miles, per hour.	Resultant direction.					
7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.			7 a. m.	2 p. m.	9 p. m.		
.636	.399	.638	.558	SW. ..	S......	S......	8.0	17.0	3.5	17.3	° S. 1 W..	10	10	10	......	......
.797	.515	.719	.677	W.NW	W.....	W.....	4.7	4.4	3.5	14.3	N. 88 W.	5	5	10	......	......
.890	.557	.628	.692	NW...	NW...	NW...	2.5	1.0	3.0	2.3	N. 45 W.	5	7	10	......	......
.645	.645	.792	.694	E.NE..	E. NE.	NE. ..	2.0	3.0	5.0	3.3	N. 58 E.	10	10	7	......	......
.782	.719	.782	.761	NE....	NE. ..	NE. ..	3.5	4.0	3.4	3.7	N. 45 E.	3	0	0	......	......
......	.373	.703	.538	E.SE..	W.SW.	SW ...	2.0	3.4	0.5	1.0	S. 33 W.	0	0	0	......	......
.883	.455	.802	.713	SW. ..	SW. ..	SW. ..	1.0	2.0	1.5	1.6	S. 45 W.	0	0	0	......	......
.738	.620	.921	.760	SW. ..	SW ...	SW. ..	2.0	3.2	1.0	2.0	S. 45 W.	4	10	7	......	......
.920	.546	.691	.719	SW ...	W.SW.	W.SW.	4.0	5.3	1.7	3.7	S. 60 W.	7	2	4	......	......
.890	.762	.843	.832	W.SW.	NE. ..	E.....	0.3	1.3	11.5	4.3	N. 86 E.	3	10	10	......	......
.824	.677	.726	.742	SW ...	SW. ..	SW. ..	6.7	6.3	3.5	5.0	S. 45 W.	10	8	6	......	.24
.719	.563	.800	.694	W.....	W.....	W.....	1.5	3.0	0.3	1.6	West...	8	3	4	......	......
.782	.554	.829	.722	SE....	E.SE..	SE....	1.5	6.0	2.5	3.3	S. 60 E.	5	8	8	......	......
.543	.921	.847	.770	S......	S.SW.	S......	11.0	10.0	9.5	10.0	S. 7 W.	10	10	10	......	......
.907	.833	.903	.881	N.	N.NW	NW...	6.0	4.0	4.0	4.3	N. 19 W.	10	10	10	......	.54
.895	.636	.626	.719	W.....	W.NW	W.NW	3.0	6.4	4.0	4.3	N. 73 W.	10	9	10	......	.18
.898	.597	.905	.800	W.....	W.....	W.....	1.0	3.0	2.5	2.2	West...	4	9	5	......	......
.820	.691	.916	.809	S.SW.	SW. ..	SE....	4.0	2.3	2.7	2.7	S. 7 W.	8	7	10	......	.04
.918	.840	.824	.861	E.....	S.....	NW...	6.0	0.7	4.5	1.3	S. 47 E.	10	10	10	......	.20
.820	.820	.893	.844	W.....	N.NW.	N.NW.	2.5	8.0	1.5	3.7	N. 37 W.	10	10	9	......	.54
.788	.728	.794	.790	W.NW	W....	SE....	4.0	4.7	5.3	1.7	S. 64 W.	8	10	10	......	......
.898	1.000	.896	.931	E.....	N.....	N.....	4.0	11.5	14.0	8.7	N. 9 E..	10	10	10	......	.36
......	1.000	......	1.000	NW...	NW...	NW...	1.0	6.7	5.0	4.0	N. 45 W.	6	9	10	......	.16
......	.896	......	.896	NW...	W.....	W.....	1.5	4.7	4.0	3.3	N. 84 W.	2	7	9	......	......
......	.476	.800	.638	W.....	S......	S......	0.3	6.0	5.0	3.7	S. 2 W.	2	3	4	......	......
.794	.645	.750	.730	S.SW.	S.SW.	SW. ..	3.0	7.0	4.0	4.3	S. 30 W.	7	10	10	......	......
.645	.598	.850	.698	S......	S......	S......	6.5	9.7	13.0	9.7	South ..	8	10	10	......	......
.859	.927	.820	.869	S......	W....	W....	9.5	3.8	3.0	3.7	S. 33 W.	10	10	10	......	.16
.792	.797	.792	.794	W.NW	W.NW	W.NW	5.0	3.7	2.7	3.7	N. 67 W.	10	10	10	......	.24
1.000	......	......	1.000	W.....	W.....	W.....	7.0	5.8	6.0	6.3	West...	10	10	10	......	......
.811	.702	.795	.771	....	....	....	....	....	...	1.9	S. 56 W.	6.9	7.6	4.4	......	2.66
......	......	......	......	W.....	W.....	W.....	2.5	2.0	3.5	2.7	West...	10	10	10	......	......
......	......	......	......	S.SW.	S......	S......	7.7	10.5	8.0	8.7	S. 6 W.	6	5	4	......	......
......	......	......	......	S......	S.SE..	S SE..	16.3	15.5	20.5	17.0	S. 15 E.	8	10	10	......	......
......	......	......	......	W.....	W.....	W.....	3.3	6.7	0.3	3.4	West...	10	5	4	......	.22
......	......	......	......	W.SW.	SW. ..	SE....	0.3	1.5	1.5	0.7	S. 7 W.	4	7	10	......	......
......	......	......	......	E. NE.	S......	S......	4.0	4.3	3.0	2.3	S. 34 E.	10	10	10	......	......
......	......	......	......	W.SW.	SW. ..	E.....	1.0	1.0	4.3	1.0	S. 66 E.	8	9	10	......	......
......	......	......	......	SW. ..	SW. ..	SW. ..	13.0	14.3	13.5	13.3	S. 45 W.	10	6	8	......	.50
......	......	......	......	W.....	W.....	W.....	8.5	8.5	9.0	8.7	West...	4	8	6	......	......
......	......	......	......	W.....	W....	W.....	6.5	7.0	7.0	6.8	West...	8	6	10	......	......
......	......	......	......	SW. ..	W.SW.	W.....	8.0	8.7	7.3	7.3	S. 66 W.	10	9	10	......	......
......	......	......	......	W.....	W	W.....	5.8	8.5	5.5	6.6	West...	10	8	10	......	......
......	......	......	......	SW. ..	SW. ..	SW ...	6.0	2.0	4.0	4.0	S. 45 W.	10	10	8	......	......
......	......	......	......	N.NW.	N.NE.	NE. ..	7.0	5.0	4.7	5.0	N. 10 E.	6	8	10	......	.14
......	......	......	......	NE. ..	NE. ..	NE. ..	10.0	10.0	13.7	11.0	N. 45 E.	6	10	10	......	......
......	......	......	......	NE. ..	W.NW	N.NW	8.0	9.5	8.5	6.3	N. 20 W.	10	10	10	......	.02
......	......	......	......	W.....	W.....	W.....	9.5	3.0	0.3	4.3	West...	10	2	6	......	.14
......	......	......	......	SW. ..	SW ...	SW. ..	4.5	5.0	6.5	5.3	S. 45 W.	8	6	10	......	......
......	......	......	......	S.SW.	W.....	N.....	3.0	4.0	10.0	3.0	N. 36 W.	10	10	10	......	......
......	......	......	......	N.....	N.....	N.....	8.0	7.0	10.5	8.5	North ..	8	4	8	......	.18
......	......	......	......	NE ...	SE....	SE....	5.7	10.5	4.5	5.3	S. 66 E.	10	8	10	......	......
......	......	......	......	S......	S	S......	10.3	14.0	10.5	11.6	South ..	10	10	10	......	......
......	......	......	......	SW. ..	SW. ..	SW ...	3.0	0.5	5.5	3.0	S. 45 W.	10	10	10	......	.14
......	......	......	......	W.....	W.....	W.....	5.5	6.0	2.0	4.5	West. ..	10	10	10	......	.52
......	......	......	......	W.....	W.....	W....	5.0	5.3	2.3	4.2	West. ..	10	10	10	......	.06
......	......	......	......	SW. ..	SW. ..	NW...	6.0	3.0	6.5	3.7	S. 81 W.	10	10	10	......	......
......	......	......	......	NW...	NW...	NW...	6.5	9.0	5.5	7.0	N. 45 W.	4	8	7	......	.08
......	......	......	......	NW...	NW...	NW...	5.3	3.7	5.5	6.3	N. 45 W.	4	3	3	......	......
......	......	......	......	SW. ..	SW. ..	SW. ..	4.0	5.5	5.3	5.0	S. 45 W.	7	10	10	......	......
......	......	......	......	SW. ..	SW. ..	SW ...	3.5	2.5	3.0	3.0	S. 45 W.	10	4	10	......	......
......	......	......	......	SW. ..	SW. ..	SW. ..	5.5	3.5	4.0	4.3	S. 45 W.	10	10	10	......	......
......	......	......	......	....	....	....	....	....	....	2.6	S. 66 W.	8.4	7.7	8.8	......	2.00

Reductions of the monthly meteorological register of the survey of

Date.	Barometer reduced to temperature of 32° Fah., expressed in United States inches and decimals.				TEMPERATURE—FAHRENHEIT.										VAPOR.			
					Wet bulb, or point of evaporation.			Dry bulb, or temperature of the open air.				Maximum.	Minimum.		Elasticity, in U. S. inches and decimals.			
	7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	Mean.				7 a. m.	2 p. m.	9 p. m.	Mean.
1866.					°	°	°	°	°	°	°	°	°					
July 1	29.604	29.583	29.548	29.578	64	68	64	67	81	67	71.7	81	55		.556	.510	.556	.541
2	29.574	29.498	29.438	29.503	65	70	71	67	85	76	76.0	88	63		.591	.531	.691	.604
3	29.358	29.248	29.170	29.259	64	71	64	66	84	67	72.3	84	65		.569	.583	.556	.569
4	29.078	29.142	29.198	29.139	60	68	68	63	81	73	72.3	82	61		.478	.510	.618	.535
5	29.265	29.262	29.312	29.280	70	79	76	75	92	83	83.0	94	67		.666	.814	.816	.765
6	29.460	29.339	29.289	29.363	72	80	72	77	95	77	83.0	96	73		.718	.820	.718	.752
7	29.355	29.289	29.249	29.298	74	78	73	77	90	76	81.0	91	70		.799	.796	.771	.789
8	29.297	29.352	29.415	29.355	72	72	65	77	84	73	78.0	84	71		.718	.623	.510	.617
9	29.515	29.499	29.525	29.513	60	70	62	64	82	65	70.3	83	62		.465	.572	.516	.518
10	29.518	29.552	29.560	29.543	58	70	65	67	80	68	71.7	83	55		.363	.598	.577	.513
11	29.596	29.581	29.531	29.569	54	70	68	56	87	71	71.3	88	52		.391	.504	.644	.513
12	29.525	29.499	29.459	29.494	65	77	76	69	93	80	80.7	96	61		.564	.711	.843	.706
13	29.454	29.383	29.341	29.393	75	85	78	79	91	82	84.0	10.2	67		.814	.121	.904	.613
14	29.359	29.423	29.387	29.390	72	84	77	75	99	85	86.3	10.2	73		.744	.961	.819	.841
15	29.444	29.409	29.409	29.421	74	83	78	80	99	87	88.7	102.5	69		.758	.910	.836	.835
16	29.451	29.458	29.449	29.453	70	83	80	76	99	85	86.7	10.3	73		.652	.910	.955	.839
17	29.457	29.399	29.367	29.408	74	70	74	78	79	77	78.0	80	72		.785	.612	.799	.732
18	29.272	29.277	29.403	29.317	71	73	65	75	80	70	75.0	85	69		.704	.717	.550	.657
19	29.453	29.448	29.423	29.441	65	68	65	68	74	70	70.7	76	60		.577	.604	.550	.577
20	29.396	29.411	29.371	29.393	64	67	68	67	73	71	70.3	75	63		.556	.581	.644	.594
21	29.305	29.248	29.235	29.263	71	77	70	75	86	74	78.3	87	68		.704	.805	.679	.729
22	29.223	29.195	29.204	29.207	70	79	73	73	90	79	80.7	92	65		.693	.841	.730	.755
23	29.381	29.304	29.320	29.335	66	76	73	69	87	76	77.3	89	67		.599	.748	.771	.706
24	29.355	29.349	29.375	29.360	62	71	73	65	86	76	75.7	90	64		.516	.556	.771	.614
25	29.415	29.411	29.442	29.423	69	82	75	72	92	79	81.0	95	69		.668	.956	.814	.813
26	29.465	29.439	29.434	29.446	62	77	76	65	90	81	78.7	92	62		.516	.752	.829	.699
27	29.425	29.382	29.347	29.385	71	75	75	75	92	78	81.7	92	78		.704	.636	.827	.723
28	29.290	29.204	29.217	29.237	70	80	72	73	93	74	80.0	94.5	72		.693	.847	.757	.766
29	29.235	29.184	29.204	29.208	67	75	75	70	85	80	78.3	93	72		.622	.733	.800	.718
30	29.283	29.277	29.338	29.299	67	75	69	70	89	72	77.0	92	64		.622	.678	.668	.656
31	29.375	29.328	29.235	29.313	60	75	72	67	88	79	78.0	89	55		.425	.692	.690	.602
Means..	29.393	29.367	29.361	29.374	....	....	....	70.9	89.9	75.8	78.9	......	....		.620	.685	.716	.674
Aug. 1	29.125	29.109	29.175	29.136	68	75	67	71	88	71	76.7	92	69		.644	.692	.608	.648
2	29.253	29.325	29.395	29.324	55	72	67	60	86	70	72.0	86	59		.367	.596	.622	.528
3	29.438	29.423	29.325	29.395	58	72	70	60	89	74	74.3	89	53		.456	.555	.679	.563
4	29.326	29.395	29.471	29.397	61	70	62	61	82	65	70.3	83	62		.497	.572	.516	.528
5	29.539	29.503	29.505	29.516	57	72	63	59	86	67	70.7	87	59		.439	.596	.522	.519
6	29.543	29.431	29.428	29.467	64	62	63	67	65	65	65.7	72	65		.556	.516	.549	.540
7	29.423	29.405	29.375	29.401	57	69	63	60	82	67	69.7	89	57		.426	.534	.522	.494
8	29.346	29.088	28.975	29.136	61	65	71	64	73	74	70.3	75	60		.497	.510	.718	.575
9	29.299	29.341	29.248	29.296	53	69	62	58	79.5	64	67.2	84	55		.336	.567	.529	.477
10	29.431	29.425	29.441	29.432	58	70	61	60	83	64	69.0	86	51		.456	.558	.497	.504
11	29.503	29.503	29.491	29.499	65	65	67	69	74	70	71.0	74	59		.564	.497	.622	.561
12	29.383	29.278	29.208	29.290	68	74	71	71	82	74	75.7	82	63		.644	.731	.718	.698
13	29.213	29.194	29.202	29.203	72	74	71	75	87	74	78.7	89.5	66		.744	.664	.718	.709
14	29.318	29.312	29.245	29.292	64	77	69	70	89	72	77.0	91	64		.516	.765	.668	.650
15	29.454	29.563	29.624	29.547	62	64	60	65	71	65	67.0	70	50		.516	.503	.451	.490
16	29.700	29.626	29.606	29.644	56	68	60	60	79	62	67.0	80	40		.396	.537	.491	.475
17	29.612	29.538	29.491	29.547	47	63	62	50	81	65	65.3	83	39		.283	.349	.516	.383
18	29.454	29.348	29.280	29.361	58	71	72	61	87	75	74.3	89	46		.443	.543	.744	.577
19	29.246	29.225	29.291	29.254	63	66	63	68	80	66	71.3	83	59		.577	.452	.536	.552
20	29.347	29.288	29.268	29.301	47	67	71	48	78	74	66.7	80	43		.310	.514	.718	.514
21	29.267	29.196	29.191	29.218	55	63	65	57.5	74	67	66.2	79	49		.400	.429	.591	.473
22	29.282	29.171	29.281	29.245	52.5	62	59	57	72	62	63.7	74	50		.336	.422	.460	.406
23	29.245	29.254	29.308	29.269	50	56	55	52	67	57	58.7	68	38		.334	.303	.407	.348
24	29.360	29.346	29.382	29.363	48	59	55	52.5	70	57	59.8	73	44		.276	.351	.407	.345
25	29.480	29.439	29.406	29.442	41	60	58	45	71	60	58.7	73	38		.205	.371	.456	.344
26	29.372	29.276	29.283	29.310	56	62	62	61	83	65	69.7	85	43		.396	.275	.516	.396
27	29.202	29.270	29.268	29.247	58	69	71	60	86	74	73.0	87	49		.456	.480	.718	.551
28	29.272	29.250	29.278	29.267	48	69	70	50	87	74	70.3	89	46		.309	.467	.679	.485
29	29.338	29.311	29.301	29.317	60	70	63	62	82	67	70.3	84	58		.491	.572	.522	.528
30	29.284	29.241	29.251	29.259	51	66	66	63	71	69	67.7	76	56		.216	.572	.599	.462
31	29.256	29.193	29.177	29.209	62	70	69	67	80	71	72.7	81	60		.489	.598	.682	.590
Means..	29.365	29.331	29.328	20.341	....	....	....	60.8	80.1	67.8	69.5	......	....		.438	.519	.580	.512

the northern and northwestern lakes at Monroe City, Michigan.

VAPOR.				WIND.								Amount of cloudiness. (0 = clear sky.) (10 = sky entirely overcast.)			Amount of evaporation in U. S. inches and decimals.	Amount of rain or melted snow, in U. S. inches and decimals.
Humidity. Saturation = 1,000.				Direction. From whence.			Velocity, in miles, per hour.			Resultant velocity, in miles, per hour.	Resultant direction.					
7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.			7 a. m.	2 p. m.	9 p. m.		
.841	.483	.841	.722	E	S	SW	2	2	2	1.3	S. 10° E.	8	10	9	......	......
.893	.442	.771	.702	SW	S	SE	4	25	12	12.3	S. 9 E.	5	6	2	......	.05
.891	.501	.841	.744	E	S	SW	12	25	2	9.3	S. 22 E.	1	9	8	......	......
.831	.483	.761	.692	SW	SW	S.SW	2	12	12	8.7	S. 34 W.	1	4	1	......	.63
.768	.543	.747	.686	S	S	SE	4	12	2	6.0	S. 5 E.	1	3	0	......	......
.774	.498	.774	.682	S. SE	SE	SW	2	25	25	12.3	S. 1 E.	2	5	1	......	......
.862	.565	.860	.762	S	SE	E	12	4	12	7.0	S. 45 E.	5	7	10	......	.22
.774	.535	.629	.646	E	NE	NE	4	12	2	5.7	N. 55 E.	5	4	5	......	.32
.780	.524	.836	.713	N	W	NW	2	2	2	1.6	N. 45 W.	10	2	2	......	......
.550	.585	.843	.659	N	NE	N	4	12	4	6.3	N. 27 E.	0	2	1	......	......
.872	.393	.850	.705	NW	SE	E	4	12	4	3.7	S. 59 E.	0	0	1	......	......
.769	.459	.824	.684	SW	S	S	2	2	2	2.0	S. 13 W.	0	0	0	......	......
.822	.771	.828	.867	SW	W.SW.	SW	12	2	2	5.3	S. 47 W.	1	5	4	......	......
.858	.516	.681	.685	W	SW	SW	12	4	2	5.7	S. 75 W.	4	4	0	......	......
.741	.489	.652	.627	S	W	SW	2	25	2	9.0	S. 83 W.	0	2	0	......	......
.727	.489	.794	.670	S	S. SW	W	2	25	2	9.7	S. 24 W.	1	4	3	......	......
.819	.618	.862	.766	W	SW	W	2	12	2	5.0	S. 56 W.	0	10	5	......	......
.812	.701	.751	.755	SE	E	NE	2	12	4	5.7	N. 85 E.	9	8	10	......	.22
.843	.720	.751	.771	NE	E	N	4	25	2	9.3	N. 80 E.	7	5	5	......	.32
.841	.716	.830	.802	NE	NE	E	4	12	4	6.3	N. 54 E.	10	10	9	......	.10
.812	.648	.810	.757	S	S	SE	2	2	2	2.0	S. 13 E.	10	5	10	......	.11
.854	.597	.738	.730	SE	SE	S.SW	2	2	4	2.3	S. 14 E.	10	5	1	......	.24
.846	.584	.860	.763	NE	E	S	2	2	2	1.3	S. 79 E.	5	1	0	......	......
.836	.448	.860	.718	S	SE	SE	2	2	4	2.7	S. 38 E.	5	5	0	......	......
.852	.637	.822	.770	NW	N.NE	NE	2	12	12	8.0	N. 29 E.	4	1	0	......	......
.836	.534	.784	.718	E	E	SE	4	2	2	2.7	S. 81 E.	0	5	9	......	......
.812	.425	.863	.700	S	S.SW	S.SW	2	2	2	2.0	S. 15 W.	7	6	5	......	......
.854	.548	.903	.768	NW	NE	SE	2	12	4	4.0	N. 54 E.	5	8	1	......	......
.848	.609	.782	.746	S	SE	SW	2	2	2	1.6	South	0	0	10	......	.06
.848	.497	.852	.732	Calm	NW	N	0	12	2	4.7	N. 39 W.	0	3	0	......	......
.642	.523	.697	.621	W	S	E	2	4	12	3.7	S. 68 E.	0	5	5	......	......
.810	.551	.797	.719	....	....	....	....	....	....	1.9	S. 22 E.	3.7	4.6	3.8	......	2.27
.850	.523	.802	.725	SE	S.SW	NW	2	35	4	11.3	S. 26 W.	8	5	0	......	.14
.708	.480	.848	.679	NW	W	NW	35	2	2	13.0	N. 47 W.	1	5	1	......	......
.880	.407	.810	.699	SW	SW	SW	4	25	4	11.0	S. 45 W.	3	5	10	......	......
.833	.524	.836	.731	N	NW	NW	2	2	4	2.7	N. 32 W.	4	2	1	......	.50
.878	.480	.790	.716	NW	W	N	2	12	2	4.7	N. 76 W.	0	4	1	......	......
.841	.836	.890	.856	W.NW	SW	SW	2	4	2	2.3	S. 61 W.	3	5	3	......	......
.822	.489	.790	.700	S	SW	W	2	4	2	2.3	S. 45 W.	10	10	10	......	......
.833	.629	.856	.773	SE	E	S	4	12	12	7.0	S. 45 E.	10	10	10	......	.02
.698	.564	.888	.717	N	N.NE	N	25	12	2	13.0	N. 7 E.	10	6	0	......	.03
.880	.495	.833	.736	W	SW	NW	2	12	2	4.7	S. 58 W.	2	5	1	......	......
.796	.593	.848	.746	SW	SW	W	2	2	2	1.7	S. 61 W.	10	7	10	......	.04
.850	.669	.856	.792	SE	S.SE	S	12	4	2	5.7	S. 34 E.	10	7	5	......	.35
.858	.518	.856	.744	SW	SW	W	12	25	2	13.0	S. 47 W.	3	5	1	......	......
.704	.560	.852	.705	NE	SE	SW	12	25	2	9.0	S. 67 E.	9	4	0	......	......
.836	.663	.731	.743	N	N	NE	12	25	25	19.0	N. 18 E.	10	9	5	......	.13
.765	.542	.884	.730	NE	SE	SE	2	4	2	2.0	S. 62 E.	0	0	0	......	......
.786	.341	.836	.654	N	N.NE	N	2	4	2	2.7	N. 11 E.	0	0	2	......	......
.825	.424	.858	.702	E.NE	E	E	4	2	2	2.7	N. 79 E.	3	5	3	......	......
.843	.441	.838	.707	NW	W	NW	2	4	2	2.3	N. 66 W.	5	6	0	......	.08
.925	.537	.856	.773	NW	SW	W	4	12	2	5.0	S. 67 W.	2	6	5	......	......
.844	.511	.893	.749	N	NE	NE	4	25	12	13.3	N. 41 E.	2	5	6	......	.04
.722	.539	.828	.696	NW	NW	NE	25	4	2	9.7	N. 42 W.	5	7	4	......	......
.861	.459	.874	.731	N. NE	N.NE	NW	12	25	2	12.7	N. 19 E.	1	5	3	......	......
.696	.482	.874	.684	N	W	W	25	4	4	9.0	N. 19 W.	2	9	7	......	......
.684	.490	.880	.685	W.SW.	SW	NW	4	2	2	2.3	S. 78 W.	0	9	0	......	......
.765	.244	.836	.615	W	W.SW.	W.SW.	25	25	12	20.3	S. 76 W.	3	4	0	......	......
.880	.387	.856	.708	S	SE	E	4	4	2	2.7	S. 37 E.	2	6	2	......	......
.856	.364	.810	.677	N	NE	NE	2	4	4	3.0	N. 36 E.	0	1	7	......	.12
.884	.524	.790	.733	E	S	W.SW.	2	2	2	1.0	S. 12 E.	10	1	9	......	......
.375	.754	.846	.658	S	S	SE	4	4	12	6.3	S. 28 E.	10	9	7	......	......
.740	.585	.899	.741	S	SE	NE	2	12	25	9.3	N. 75 E.	5	4	0	......	.08
.797	.518	.813	.719	....	....	....	....	....	....	1.2	N. 46 W.	4.6	5.3	3.6	......	1.53

Reductions of the monthly meteorological register of the survey of

Date.	Barometer reduced to temperature of 32° Fahr., expressed in U. S. inches and decimals.				TEMPERATURE—FAHRENHEIT.									VAPOR.			
					Wet bulb, or point of evaporation.			Dry bulb, or temperature of the open air.				Maximum.	Minimum.	Elasticity, in U.S. inches and decimals.			
	7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	Mean.			7 a. m.	2 p. m.	9 p. m.	Mean.
1866.					°	°	°	°	°	°	°	°	°				
Sept. 1	29.137	29.102	29.120	29.120	70	75	76	73	89	76	79.3	92	64	.693	.678	.897	.756
2	29.132	29.222	29.313	29.222	73	79	67	76	85	69	76.7	89	66	.771	.909	.635	.772
3	29.388	29.373	29.428	29.396	59	70	60	65	82	63	70.0	82	57	.420	.572	.478	.490
4	29.374	29.231	29.241	29.282	53	70	69	57	78	71	68.7	79	52	.358	.625	.682	.552
5	29.368	29.395	29.443	29.402	59	66	59	63	79	61	67.7	80	57	.447	.465	.473	.462
6	29.482	29.431	29.416	29.443	49	68	65	53	84	67	68.0	84	45	.295	.470	.591	.452
7	29.331	29.213	29.249	29.264	57	59	57	62	63	61	62.0	68	57	.399	.447	.412	.419
8	29.354	29.396	29.494	29.415	54	63	58	57	64	60	60.3	76	50	.378	.562	.456	.465
9	29.610	29.648	29.601	29.620	55	66	57	57	76	58	63.7	76	44	.407	505	.452	.455
10	29.544	29.426	29.316	29.429	57	68	63	60	75	65	66.7	75	44	.426	.591	.549	.555
11	29.080	29.012	29.020	29.037	66	70	62.5	69	75	67	70.3	76	63	.599	.666	.506	.570
12	29.035	29.055	29.198	29.096	60	65	57	63	77	59	66.3	77	56	.478	.591	.439	.503
13	29.037	29.334	29.345	29.339	50	62	53	52.5	67	55	58.2	69	49	.328	.489	.376	.398
14	29.327	29.408	29.541	29.425	45	64	48	48	74	49	57.0	74	44	.260	.462	.322	.348
15	29.620	29.664	29.580	29.621	44	51	53	45	62	55	54.0	65	34	.275	.229	.376	.293
16	29.465	29.336	29.263	29.355	53	63	63	58	68	67	64.3	68	55	.336	.509	.522	.456
17	29.359	29.399	29.364	29.374	59	57	52	62	63	55	60.0	67	54	.460	.386	.349	.398
18	29.288	29.245	29.263	29.265	50	45	48	52	50	50	50.7	56	48	.334	.234	.309	.292
19	29.305	29.385	29.427	29.372	46	55	51	48.5	58	54	53.5	58	48	.278	.393	.335	.335
20	29.290	29.126	29.156	29.191	49	51	49	51	53	51	51.7	53	48	.321	.348	.321	.330
21	29.328	29.472	29.535	29.445	43	49	45	45	55	47	49.0	59	43	.251	.269	.273	.264
22	29.601	29.540	29.531	29.557	38	59	53	40	67	54	53.7	67	33	.203	.393	.389	.328
23	29.493	29.455	29.410	29.453	49	61	55	53	69	57	59.7	69	45	.295	.439	.467	.377
24	29.342	29.306	29.404	29.351	54	62	62	57	67	66	63.3	67	53	.378	.489	.502	.456
25	29.392	29.374	29.475	29.414	55	57	47	58	59	49	55.3	66	48	.393	.439	.297	.376
26	29.593	29.582	29.587	29.587	43	55	48	45	63	51	53.0	67	43	.251	.327	.296	.291
27	29.603	29.568	29.604	29.592	42	70	57	44	79	59	60.7	80	39	.241	.612	.439	.431
28	29.633	29.576	29.612	29.607	43	62	53	46	74	56	58.7	78	43	.238	.396	.363	.332
29	29.607	29.568	29.594	29.590	45	71	53	48	79	55	60.7	79	45	.260	.651	.376	.429
30	29.565	29.546	29.566	29.559	54	73	60	63	81	63	69.0	81	44	.298	703	.478	.493
Means....	29.399	29.379	29.403	29.394	....	....	....	55.7	70.5	59.0	61.7	....	....	.369	.495	.443	.436
Oct. 1	29.578	29.544	29.456	29.526	45.5	64	61.5	48.5	71	63	60.8	73	46.5	.265	.503	.526	.431
2	29.387	29.321	29.371	29.360	46	73	64	49.5	85	67	67.2	85	47	.265	.650	.556	.490
3	29.480	29.429	29.487	29.465	44	63	47	47	69	49	55.0	69	44	.249	.495	.297	.347
4	29.610	29.667	29.747	29.675	43	50	44	47	59	46	50.7	59	43	.225	.242	.262	.243
5	29.875	29.856	29.813	29.848	40	55	40	43.5	61	43	49.2	63	35	.202	.354	.208	.255
6	29.791	29.669	29.632	29.697	33.5	63	54	35.5	74	57	55.5	74	32	.166	.429	.378	.324
7	29.642	29.571	29.532	29.582	55	70	60	57	79	63	66.3	82	47	.407	.612	.478	.499
8	29.492	29.363	29.338	29.398	51	72	61	53	79	65	65.7	81	48	.348	.690	.483	.507
9	29.312	29.266	29.178	29.252	57	62	57	59	69	59	62.3	69	57	.439	.462	.439	.447
10	29.245	29.312	29.370	29.309	51	61	55	54	67	57	59.3	69	57	.335	.457	.407	.400
11	29.412	29.369	29.389	29.390	57	59	53	59	63	54	58.7	64	53	.439	.447	.389	.425
12	29.384	29.379	29.382	29.382	54	65	55	57	71	59	62.3	71	56	.378	.537	.380	.332
13	29.482	29.520	29.560	29.521	48	55	55	50	69	57	58.7	69	47	.309	.247	.407	.321
14	29.675	29.689	29.764	29.709	47	64	52	50	73	54	59.0	75	43	.283	.476	.362	.374
15	29.834	29.835	29.868	29.846	40	62	50	42	72	53	55.7	73	41	.221	.422	.321	.321
16	29.832	29.759	29.699	29.763	42	69	57	43	78	59	60.0	80	41	.254	.588	.439	.427
17	29.633	29.528	29.492	29.551	43	62	57	44	77	60	60.3	82	41	.264	.356	426	.349
18	29.501	29.422	29.392	29.438	56	64	59	58	77	62	65.7	81	36	.422	.556	.460	.479
19	29.392	29.404	29.436	29.411	54	65	61	59	72	64	65.0	72	54	.351	.524	.497	.457
20	29.462	29.426	29.396	29.428	57	67	64	60	78	67	68.3	78	59	.426	.514	.556	.499
21	29.269	29.103	29.050	29.141	58	62	64	62	73	66	67.0	74	50	.429	.409	.569	.469
22	29.033	29.202	29.263	29.166	47	53	47	49	63	50	54.0	67	49	.297	.270	.283	.283
23	29.264	29.226	29.366	29.285	39	45	34	42	49	35	42.0	50	35	.199	.247	.183	.210
24	29.434	29.451	29.486	29.457	35	37	36	39	43	37	39.7	43	33	.152	.142	.199	.164
25	29.559	29.531	29.476	29.522	35	46	37	36	53	39	42.7	53	33	.191	.219	.194	.201
26	29.281	29.288	29.386	29.318	38	43	37	40	47	40	42.3	47	40	.203	.225	.181	.203
27	29.659	29.578	29.601	29.613	34	[illegible]	40	36	50	42	42.7	50	34	.170	.209	.221	.200
28	29.376	29.208	29.240	29.274	44	55	54	47	62	57	55.3	64	42	.249	.340	.378	.322
29	29.292	29.215	29.191	29.233	43	42	42	44	52	45	47.0	57	43	.264	.136	.228	.209
30	29.205	29.222	29.332	29.253	38	39	39	41	46	41	42.7	46	39.5	.190	.147	.212	.183
31	29.560	29.586	29.589	29.578	30	35	32	32	+1	35	36.0	43	31	.144	.126	.142	.137
Means....	29.482	29.449	29.461	29.464	....	....	....	47.9	65.2	53.1	55.4	....	....	.282	.389	.357	.343

the northern and northwestern lakes at Monroe City, Michigan.

VAPOR.				WIND.								Amount of cloudiness. (0 = clear sky.) 10 = sky entirely overcast.)			Amount of evaporation, in U. S. inches and decimals.	Amount of rain or melted snow, in U. S. inches and decimals.
Humidity. Saturation = 1,000.				Direction. From whence.			Velocity, in miles per hour.			Resultant velocity, in miles, per hour.	Resultant direction.					
7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.			7 a. m.	2 p. m.	9 p. m.		
.854	.497	1.000	.784	S	S	S	12	2	2	5.3	South	2	5	7	......	.03
.860	.756	.896	.837	W	W	W	12	4	2	6.0	West	6	3	2	......	......
.680	.524	.831	.678	SW	W	NW	2	2	4	2.3	N. 79 W.	5	2	1	......	......
.752	.653	.899	.768	SE	E	SE	2	12	4	5.7	S. 75 E	3	10	2	......	......
.776	.470	.882	.709	N	NW	NW	25	4	2	10.0	N. 8 W.	1	9	0	......	.19
.733	.403	.893	.676	W	SW	SW	2	4	2	2.7	S. 58 W.	0	6	3	......	......
.718	.776	.769	.754	NE	NE	NE	4	12	4	6.7	N. 45 E	10	10	10	......	.45
.812	.943	.880	.878	W	W	NW	25	35	2	20.3	N. 89 W.	2	9	1	......	.68
.874	.563	.937	.791	N	W	SE	4	4	4	0.6	N. 45 W.	5	7	2	......	......
.822	.681	.890	.798	SE	NE	NE	4	25	12	12.7	N. 51 E	10	7	10	......	......
.846	.768	.764	.793	E. SE	SW	SW	12	25	45	22.1	S. 35 W.	10	2	5	......	.31
.831	.893	.878	.867	SW	SW	SW	45	60	4	36.3	S. 45 W.	10	4	2	......	.48
.829	.740	.869	.813	W	W	W	12	2	4	6.0	West	10	2	0	......	......
.777	.551	.926	.751	W	W	N	4	45	2	16.7	N. 87 W.	1	5	0	......	......
.920	.412	.869	.734	N	N	N	2	12	25	13.0	North	3	5	10	......	......
.698	.743	.790	.744	S	S	S	12	4	2	6.0	South	10	5	10	......	.04
.828	.670	.805	.768	N	NE	NE	25	2	4	10.0	N. 8 E	10	10	10	......	.40
.861	.646	.856	.788	NE	NE	NE	25	25	35	28.3	N. 45 E	10	10	10	......	.16
.815	.816	.802	.811	N	N	N	35	25	4	21.3	North	10	10	9	......	.45
.859	.864	.859	.861	NE	NE	NE	25	35	25	28.3	N. 45 E	10	10	10	......	.23
.840	.620	.847	.769	NW	NW	N	35	12	2	16.0	N. 43 W.	9	5	0	......	.13
.820	.595	.933	.783	NE	NE	E	2	2	12	5.0	N. 79 E.	0	2	2	......	......
.733	.607	.874	.738	NW	SE	SE	4	25	4	8.3	S. 45 E.	0	0	0	......	......
.812	.740	.786	.779	S	S	S	12	12	2	8.7	South	5	10	10	......	......
.816	.878	.853	.849	N	N	N	4	12	4	6.7	North	10	10	10	......	.44
.840	.568	.790	.733	N	S	SW	2	2	4	1.3	S. 45 W.	0	1	2	......	1.12
.836	.618	.878	.777	SW	SW	W	12	12	2	8.7	S. 47 W.	0	2	0	......	......
.767	.472	.809	.683	N	SW	NW	2	12	2	3.7	S. 62 W.	0	1	0	......	......
.777	.657	.869	.768	N	E	NE	2	2	4	2.3	N. 45 E	1	3	0	......	......
.519	.665	.831	.672	NW	SW	SW	4	4	2	2.7	S. 80 W.	4	5	5	......	......
.797	.659	.859	.772	......	......	......	....	....	....	2.2	N. 43 W.	5.2	5.7	4.4	......	5.11
.779	.663	.914	.785	N	W	E	2	4	4	0.7	North	2	7	0	......	......
.748	.540	.841	.710	E	SE	NE	2	35	25	15.0	S. 81 E	1	4	10	......	......
.772	.700	.853	.775	N	NE	NE	4	12	2	5.7	N. 35 E	3	0	0	......	......
.698	.484	.843	.675	N	N	N	4	4	4	4.0	North	4	4	1	......	......
.713	.659	.750	.705	E.NE	E.SE	E	25	25	12	20.3	S. 72 E	2	3	3	......	......
.799	.511	.812	.707	W.NW	NE	NE	4	25	2	8.7	N. 37 E.	0	0	0	......	......
.874	.618	.831	.774	SW	W	W	4	4	2	3.0	S. 72 W.	7	5	2	......	......
.864	.697	.783	.781	SW	NE	E	2	12	4	4.3	N. 57 E	0	4	0	......	......
.878	.653	.878	.803	W	W	W.NW	2	2	12	5.3	N. 74 W.	7	7	10	......	.33
.802	.690	.874	.789	NE	NE	E	2	4	12	5.7	N. 75 E.	0	5	8	......	.72
.878	.776	.933	.862	E	N	SE	12	2	4	6.0	N. 85 E.	10	10	10	......	......
.812	.708	.761	.760	N	NE	NE	2	4	12	6.0	N. 41 E	10	5	3	......	......
.856	.350	.874	.693	SE	SE	SE	4	4	4	4.0	S. 45 E.	9	7	3	......	......
.786	.588	.867	.747	SE	S	SW	2	2	2	1.6	South	9	0	0	......	......
.829	.539	.798	.722	N	NE	N	2	25	4	8.9	N. 37 E.	0	0	0	......	......
.916	.613	.878	.802	W	S	SW	2	2	2	1.7	S. 45 W.	0	1	1	......	......
.918	.384	.822	.708	NW	W	W	4	2	2	2.3	N. 66 W.	0	2	3	......	......
.876	.841	.828	.848	NW	NE	SE	2	4	12	3.7	S. 64 E	0	0	7	......	......
.703	.668	.833	.735	S	SW	SE	2	4	12	5.0	S. 22 E.	7	9	5	......	......
.822	.537	.841	.733	E	E	E	25	4	4	11.0	East	9	3	10	......	.34
.772	.504	.891	.722	S	S	S	25	45	60	4.3	South	7	10	5	......	.06
.853	.470	.786	.703	SW	SW	SW	60	45	25	43.3	S. 45 W.	8	0	0	......	.16
.744	.710	.898	.784	SW	SW	SW	35	45	2	27.0	S. 45 W.	1	10	4	......	......
.636	.511	.903	.683	NW	NW	NW	35	2	2	13.0	N. 45 W.	2	5	9	......	......
.900	.544	.816	.753	N	NE	NE	2	2	25	9.7	N. 41 E.	10	10	10	......	......
.820	.698	.732	.750	SE	S	W	12	35	45	19.0	S. 40 W.	10	10	10	......	.17
.802	.581	.829	.737	NW	W	W	4	2	4	3.0	N. 72 W.	4	7	10	......	......
.772	.612	.812	.732	N	N.NE	NE	2	25	12	12.7	N. 29 E.	10	10	10	......	.38
.918	.350	.762	.677	N	NW	W	2	12	25	11.7	N. 72 W.	10	9	10	......	.18
.738	.471	.824	.678	SW	SW	W	25	35	25	26.7	S. 58 W.	9	7	10	......	......
.794	.488	.698	.660	NW	NW	W	25	12	4	13.3	N. 49 W.	3	6	10	......	......
.809	.586	.831	.742	......	......	......	....	....	....	2.3	S. 25 W.	5.0	5.2	5.3	......	2.34

Reductions of the monthly meteorological register of the survey of

Date.	Barometer reduced to temperature of 32° Fahr., expressed in United States inches and decimals,				TEMPERATURE—FAHRENHEIT.									VAPOR.			
					Wet bulb, or point of evaporation.			Dry bulb, or temperature of the open air.				Maximum.	Minimum.	Elasticity, in U. S. inches and decimals.			
	7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	Mean.			7 a. m.	2 p. m.	9 p. m.	Mean.
1866.					°	°	°	°	°	°	°	°	°				
Nov. 1	29.447	29.233	29.184	29.288	34	50	48	38	59	53	50.0	59	34	.144	.242	.269	.218
2	29.448	29.538	29.663	29.550	36	47	39	40	56	41	45.7	57	37	.160	.204	.212	.192
3	29.746	29.684	29.724	29.718	35	39	38	36	45	39	40.0	47	35	.191	.160	.216	.189
4	29.789	29.808	29.910	29.836	34	40	35	35	46	37	39.3	47	33	.183	.169	.178	.177
5	30.059	30.038	30.038	30.045	24	40	29	25	47	30	34.0	48	25	.117	.156	.149	.141
6	29.985	29.933	29.812	29.910	21	45	29	22	56	32	36.7	53	21	.101	.155	.126	.127
7	29.725	29.565	29.488	29.593	22	54	39	23	63	42	42.7	65	40	.107	.298	.199	.201
8	29.534	29.453	29.443	29.477	46	50	50	48	57	53	52.7	59	36	.284	.268	.321	.291
9	29.546	29.470	29.505	29.507	45	57	47	48	67	49	54.7	67	41	.260	.333	.297	.297
10	29.499	29.391	29.049	29.313	28	43	42	30	55	45	43.3	57	30	.130	.120	.228	.159
11	29.102	29.102	29.414	29.206	39	40	37	42	45	40	42.3	49	40	.199	.182	.181	.187
12	29.521	29.603	29.661	29.595	35	46	31	37	56	32	41.7	57	32	.178	.179	.162	.173
13	29.718	29.556	25.481	29.585	22	45	40	23	49	43	38.3	49	23	.107	.247	.208	.187
14	29.381	29.286	29.288	29.318	41	43	46	45	49	47	47.0	49	37	.205	.199	.297	.234
15	29.152	28.959	28.944	29.018	39	38	35	41	45	37	41.0	49	37	.212	.138	.178	.176
16	28.862	28.890	29.062	28.938	33	36	35	35	42	38	38.3	42	34	.162	.134	.165	.154
17	29.234	29.248	29.251	29.244	34	42	36	35	49	38	40.3	49	35	.183	.175	.186	.181
18	29.296	29.144	29.207	29.216	38	43	40	41	47	43	43.7	47	35	.190	.225	.208	.208
19	29.015	28.897	28.974	28.962	42	42	39	44	47	41	44.0	47	41	.241	.202	.212	.218
20	29.107	29.157	29.336	29.200	39	40	32	40	46	34	40.0	47	33	.225	.169	.155	.183
21	29.413	29.336	29.276	29.342	31	40	37	34	45	39	39.3	45	33	.139	.182	.194	.172
22	28.975	29.057	29.322	29.118	37	33	31	39	39	32	36.7	39	32	.194	.110	.162	.155
23	29.393	29.452	29.498	29.448	22	32	28	23	36	29	29.3	37	22	.107	.129	.142	.126
24	29.573	29.525	29.538	29.545	24	30	28	25	35	29	29.7	37	22	.117	.109	.142	.123
25	29.593	29.544	29.502	29.546	24	39	31	25	45	33	34.3	46	23	.117	.160	.151	.143
26	29.478	29.412	29.372	29.421	28	40	42	29	46	45	40.0	47	26	.142	.169	.228	.180
27	29.364	29.263	29.207	29.278	32	41	47	35	52	49	45.3	52	33	.142	.113	.297	.184
28	29.099	29.044	29.143	29.095	47	50	38	50	55	40	48.3	56	40	.283	.295	.203	.260
29	29.150	29.152	29.157	29.153	33	35	32	35	40	35	36.7	40	33	.162	.139	.142	.148
30	29.268	29.228	29.508	29.335	27	26	28	29	31	31	30.3	34	27	.124	.083	.119	.109
Means....	29.416	29.365	29.398	29.393	....	....	....	35.1	48.3	39.2	40.9	....	....	.170	.181	.197	.183
Dec. 1	29.625	29.593	29.563	29.594	28	30	31	30	34	33	32.3	37	27	.130	.121	.151	.134
2	29.553	29.447	29.447	29.482	25	43	33	28	48	35	37.0	48	23	.100	.212	.162	.158
3	29.310	29.107	29.080	29.166	32	40	40	35	45	43	41.0	45	23	.142	.182	.208	.177
4	29.101	29.187	29.364	29.217	40	42	32	43	50	36	43.0	50	34	.208	.162	.129	.166
5	29.530	29.576	29.602	29.569	25	40	40	27	46	42	38.3	46	25	.112	.169	.221	.167
6	29.506	29.434	29.481	29.474	42	42	44	44	47	46	45.7	47	39	.241	.202	.262	.235
7	29.488	29.386	29.179	29.351	43	48	45	45	53	47	48.3	53	43	.251	.269	.273	.264
8	29.047	28.817	29.107	28.990	50	40	30	53	47	32	44.0	53	32	.321	.156	.144	.207
9	29.166	29.168	29.299	29.211	22	23	13	23	26	15	21.3	32	13.5	107	.089	.056	.084
10	29.315	29.341	29.375	29.344	17	20	13	19	23	15	19.0	23	12	.071	.074	.056	.067
11	29.372	29.361	29.487	29.407	10	18	13	11	21	15	15.7	23	9	.057	.065	.056	.059
12	29.547	29.551	29.627	29.575	12	17	10	13.5	20	12	15.2	20	11	.058	.060	.046	.055
13	29.632	29.547	29.556	29.578	16	23	19	17	26	20	21.0	26	8	.078	.089	.092	.086
14	29.759	29.788	29.848	29.798	11	29	19	13	33	21	22.3	33	10	.049	.114	.080	.081
15	29.797	29.519	29.389	29.568	15	19	23	16.5	23	25	21.5	23	11	.069	.058	.100	.076
16	29.011	28.908	28.943	28.954	30	30	28	32	35	29	32.0	35	23	.144	.109	.142	.132
17	29.248	29.360	29.500	29.369	23	27	26.5	24	31	29	28.6	32	23	.112	.101	.101	.105
18	29.666	29.615	29.488	29.590	14	27	26	16	30.5	28	24.8	30.5	13	.059	.107	.117	.094
19	29.483	29.450	29.587	29.507	31	32	26	33	36	29	32.7	38	28	.151	.155	.106	.137
20	29.943	29.936	29.847	29.909	9.5	17	9	11.5	19	10	13.5	23.5	8.5	.044	.071	.054	.056
21	29.705	29.536	29.481	29.574	14	23	25	16	26	27.5	23.2	27.5	8	.059	.089	.106	.085
22	29.333	29.168	29.055	29.185	33	38	36	36	40	37.5	37.8	40	27	.149	.203	.192	.181
23	28.783	28.661	28.810	28.751	41	40	38	42.5	43.5	39.5	41.8	43.5	36	.238	.202	.210	.217
24	28.950	28.962	29.035	28.982	30	28	26	32	33	27	30.7	37	27	.144	.096	.129	.123
25	29.243	29.271	29.331	29.282	20	20	13	22.5	24	14	20.2	24	14	.079	.062	.067	.069
26	29.236	29.128	29.171	29.178	19	29	21	20	32	22	24.7	32	14	.092	.126	.101	.106
27	29.273	29.336	29.429	29.346	9	17	12	10	19	13	14.0	19	9	.054	.071	.063	.063
28	29.465	29.487	29.547	29.500	9	19	17	10	23	19.5	17.5	23	6	.054	.058	.066	.059
29	29.575	29.544	29.579	29.566	9	18	13	10	22	15	15.7	22	8	.054	.053	.056	.054
30	29.635	29.566	29.531	29.577	4	20	14	5	23.5	16	14.8	29	3.5	.041	.068	.059	.056
31	29.467	29.441	29.559	29.489	13	28	19	14	32	21	22.3	32.5	12	.067	.108	.080	.085
Means....	29.412	29.361	29.397	29.390	....	....	....	24.3	32.6	26.3	27.7	....	....	.114	.120	.119	.118

the northern and northwestern lakes at Monroe City, Michigan.

VAPOR.				WIND.								Amount of cloudiness. (0 = clear sky.) (10 = sky entirely overcast.)			Amount of evaporation, in U. S. inches and decimals.	Amount of rain or melted snow, in U. S. inches and decimals.
Humidity. Saturation = 1,000.				Direction. From whence.			Velocity, in miles, per hour.			Resultant velocity, in miles, per hour.	Resultant direction.					
7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.			7 a. m.	2 p. m.	9 p. m.		
											°					
.628	.484	.667	.593	NE	SE	S	4	25	12	11.3	S. 38 E.	3	2	0	......	......
.645	.455	.824	.641	S	SE	NE	2	12	25	9.0	N. 75 E.	2	7	10	......	......
.900	.533	.907	.780	NE	NE	E	2	2	4	2.3	S. 66 E.	9	10	10	......	......
.898	.543	.807	.749	NE	NE	NE	2	25	4	10.3	N. 45 E.	9	10	7	......	......
.872	.463	.890	.748	NW	NW	N	2	4	4	3.0	N. 27 W.	1	1	0	......	......
.860	.346	.694	.633	N	SE	SE	2	4	2	1.7	S. 64 E.	3	1	1	......	......
.864	.519	.744	.709	E	NE	N.NW	2	4	2	2.0	N. 42 E.	0	0	0	......	......
.850	.577	.798	.742	SW	E.SE	SE	4	4	2	2.0	S. 23 E.	2	7	3	......	......
.777	.503	.853	.711	SW	SW	SW	2	2	4	2.7	S. 45 W.	10	0	0	......	......
.782	.278	.762	.607	NE	NE	NE	4	12	45	2.3	N. 45 E.	10	10	10	......	......
.744	.607	.732	.694	SW	W	NW	25	35	25	23.5	West	5	10	10	......	.58
.807	.399	.896	.701	W	W	W	12	2	2	5.3	West	10	0	0	......	......
.864	.710	.750	.775	NE	NE	NE	2	12	25	13.0	N. 45 E.	0	5	10	......	......
.684	.572	.923	.726	E	SE	SW	12	4	2	4.7	S. 73 E.	10	10	10	......	......
.824	.459	.807	.697	N	W	NW	4	2	2	2.0	N. 33 W.	10	10	10	......	.47
.797	.500	.719	.672	SW	SW	SW	2	2	2	2.0	S. 45 W.	10	10	10	......	.16
.898	.505	.811	.738	W	SW	SW	4	25	2	10.3	S. 50 W.	6	5	3	......	......
.738	.698	.750	.729	S	S	S	2	2	2	2.0	South	10	10	9	......	......
.836	.624	.824	.761	SE	SW	NW	4	12	12	5.0	S 80 W.	10	10	9	......	......
.910	.543	.792	.748	N	N	N	4	2	2	2.7	North	10	5	5	......	.45
.712	.607	.816	.712	NE	NW	NW	4	2	2	1.9	North	5	6	10	......	......
.816	.463	.896	.725	W	W	W	2	25	2	9.7	West	10	10	5	......	.40
.864	.610	.887	.787	NW	NW	NW	4	25	25	18.0	N. 45 W.	5	3	8	......	.12
.872	.537	.887	.765	W	W	W	2	25	2	9.7	West	0	0	2	......	......
.872	.533	.800	.735	SW	SE	E	2	25	4	9.3	S. 47 E.	2	0	0	......	......
.887	.543	.762	.731	S	S	S	12	2	4	6.0	South	5	9	10	......	......
.698	.292	.853	.614	S	SE	E	2	12	25	11.7	S. 73 E.	7	6	10	......	......
.786	.681	.820	.762	SW	NW	NW	2	12	4	5.3	N. 54 W.	10	10	10	......	.10
.797	.557	.698	.624	NW	W	W	12	25	12	15.3	N. 79 W.	10	9	10	......	.22
.775	.480	.685	.647	NW	NW	W	25	35	35	29.3	N. 61 W.	10	10	10	......	.01
.808	.521	.802	.710	....	....	....	....	....	....	2.0	N. 53 W.	6.5	6.2	6.4	......	2.51
.782	.617	.800	.733	W	W	NW	12	12	2	8.3	N. 87 W.	9	8	0	......	......
.655	.631	.797	.694	SE	SE	SE	12	12	4	9.3	S. 45 E.	0	0	0	......	......
.698	.607	.750	.685	S	SE	S.SE	25	25	25	23.7	S. 23 E.	5	10	10	......	......
.750	.450	.610	.603	W	W	W	35	25	2	20.7	West	5	0	0	......	.10
.761	.512	.829	.711	NE	NE	NE	4	12	4	6.7	N. 45 E.	7	5	10	......	......
.836	.624	.843	.768	NE	N	NW	12	12	25	13.3	N. 14 W.	10	10	10	......	......
.840	.667	.847	.785	SW	SW	SW	4	35	25	21.3	S. 45 W.	9	3	10	......	.63
.798	.483	.794	.692	SW	SW	SW	35	45	60	46.3	S. 45 W.	5	9	9	......	.43
.864	.634	.648	.715	W.SW.	W.SW.	W	35	35	45	37.7	S. 76 W.	5	5	0	......	.06
.692	.598	.648	.646	W	W	W	35	35	35	35.0	West	1	5	10	......	.02
.797	.570	.648	.672	SW	SW	SW	25	25	35	28.3	S. 45 W.	6	7	10	......	......
.721	.536	.610	.629	SW	SW	SW	35	45	4	28.0	S. 45 W.	5	5	0	......	......
.834	.634	.850	.773	W	W	W	4	2	4	3.3	West	10	10	2	......	......
.623	.606	.712	.647	N	NE	NE	4	2	12	5.7	N. 35 E.	0	4	7	......	.05
.748	.467	.746	.654	NE	NE	NE	35	25	35	31.7	N. 45 E.	10	10	10	......	......
.794	.537	.887	.739	NE	NE	N	60	4	4	22.3	N. 43 E.	10	10	10	......	.25
.868	.582	.617	.689	W	W	W	12	12	4	12.7	West	9	5	8	......	.15
.659	.628	.768	.685	S	SW	W	4	4	4	3.0	S. 45 W.	8	3	5	......	......
.800	.792	.665	.752	W	W	N	4	2	25	8.7	N. 14 W.	10	10	10	......	......
.598	.692	.791	.694	NE	NE	NE	25	12	2	13.0	N. 45 E.	0	7	2	......	......
.659	.634	.707	.667	E	E	E	25	12	4	13.7	East	10	9	10	......	......
.705	.820	.856	.794	S	S	S	12	4	2	6.0	South	10	10	10	......	......
.873	.713	.863	.816	E	W	W	2	2	35	14.7	West	10	10	10	......	.24
.794	.510	.880	.728	W	W	W	12	2	35	16.3	West	10	7	10	......	.40
.658	.483	.816	.652	W	W	W	12	12	4	9.3	West	10	5	1	......	.07
.850	.694	.860	.801	S	S. SW.	SW	4	12	4	6.3	S. 23 W.	10	10	10	......	......
.791	.692	.810	.764	S	SW	SW	4	25	35	21.0	S. 42 W.	3	2	0	......	.16
.791	.467	.623	.627	W	W	W	25	25	25	25.0	West	5	4	1	......	......
.791	.449	.648	.629	W	W.NW.	NW	4	4	12	6.3	N. 58 W.	3	10	10	......	......
.750	.540	.659	.650	W	W	W	4	4	2	3.3	West	2	1	2	......	......
.816	.594	.712	.707	SW	S	SW	4	2	2	2.7	S. 32 W.	7	5	8	......	......
.768	.584	.751	.704	....	....	....	....	....	....	7.3	S. 71 W.	6.6	6.4	6.3	......	1.96

Reductions of the monthly meteorological register of the survey of

Date.	Barometer reduced to temperature of 32° Fahr., expressed in United States inches and decimals.				TEMPERATURE—FAHRENHEIT.									VAPOR.			
					Wet bulb, or point of evaporation.			Dry bulb, or temperature of the open air.				Maximum.	Minimum.	Elasticity, in U. S. inches and decimals.			
	7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	Mean.			7 a. m.	2 p. m.	9 p.m.	Mean.
1866.					°	°	°	°	°	°	°	°	°				
July 1	29. 581	29. 578	29. 545	29. 568	60	68	68	62	79	72	71. 0	82	59	. 491	. 537	. 631	. 553
2	29. 551	29. 507	29. 418	29. 492	64	75	70	67	84	75	75. 3	86	66	. 556	. 746	. 666	. 656
3	29. 385	29. 227	29. 183	29. 265	62	70	65	66	82	68	72. 0	84	65	. 502	. 572	. 577	. 550
4	29. 018	29. 135	29. 142	29. 098	66	75	63	67	80	72	73. 0	85	65	. 626	. 800	. 455	. 627
5	29. 245	29. 257	29. 274	29. 259	68	78	76	71	89	80	80. 0	93	68	. 644	. 809	. 843	. 765
6	29. 364	29. 349	29. 297	29. 337	74	80	72	78	91	75	81. 3	95	75	. 785	. 874	. 744	. 801
7	29. 328	29. 314	29. 145	29. 262	71	75	70	74	78	73	75. 0	88	73	. 718	. 827	. 693	. 746
8	29. 344	29. 285	29. 335	29. 321	70	76	71	72	80	74	75. 3	84	71	. 706	. 843	. 718	. 756
9	29. 471	29. 485	29. 463	29. 473	64	67	61	67	70	64	67. 0	76	64	. 556	. 622	. 497	. 558
10	29. 534	29. 535	29. 475	29. 515	57	70	66	60	75	69	68. 0	79	57	. 426	. 666	. 599	. 564
11	29. 516	29. 508	29. 503	29. 509	61	76	68	64	81	71	72. 0	84	64	. 497	. 829	. 644	. 657
12	29. 523	29. 470	29. 375	29. 456	62	77	73	65	85	76	75. 3	88	63	. 516	. 819	. 771	. 702
13	29. 415	29. 351	29. 409	29. 392	68	82	78	71	91	83	81. 7	93	72	. 644	. 970	. 890	. 835
14	29. 354	29. 351	29. 329	29. 345	74	83	79	80	93	84	85. 7	94	74	. 758	. 992	. 922	. 891
15	29. 410	29. 409	29. 397	29. 405	71	83	80	76	96	86	86. 0	96. 5	74	. 691	. 951	. 942	. 861
16	29. 484	29. 363	29. 424	29. 424	72	84	81	78	96	86	86. 7	97	75	. 704	. 002	. 989	. 565
17	29. 474	29. 493	29. 364	29. 444	76	85	72	83	93	78	84. 7	93	77	. 802	. 094	. 704	. 533
18	29. 297	29. 181	29. 272	29. 250	73	79	69	78	87	73	79. 3	86	72	. 744	. 882	. 655	. 760
19	29. 358	29. 372	29. 465	29. 398	66	66	65	70	74	70	71. 3	76	66	. 586	. 532	. 550	. 556
20	29. 371	29. 345	29. 293	29. 336	63	68	67	67	72	72	70. 3	76	65	. 522	. 631	. 595	. 583
21	29. 263	29. 212	29. 198	29. 224	67	70	72	71	75	75	73. 7	79	67	. 608	. 666	. 744	. 673
22	29. 172	29. 177	29. 154	29. 168	68	77	74	71	84	79	78. 0	85	67	. 644	. 832	. 772	. 749
23	29. 228	29. 245	29. 263	29. 245	69	72	70	73	79	74	75. 3	80	72	. 655	. 655	. 690	. 667
24	29. 351	29. 320	29. 300	29. 324	63	74	70	67	82	74	74. 3	82	62	. 522	. 731	. 679	. 644
25	29. 348	29. 357	29. 262	29. 322	65	78	71	68	84	77	76. 3	84	65	. 577	. 877	. 678	. 711
26	29. 388	29. 400	29. 355	29. 381	62	73	71	65	83	75	74. 3	84	63	. 516	. 677	. 704	. 632
27	29. 352	29. 339	29. 272	29. 321	70	78	71	75	87	77	79. 7	88	71	. 666	. 836	. 678	. 727
28	29. 165	29. 232	29. 180	29. 192	65	78	72	67	84	78	76. 3	86	67	. 591	. 877	. 704	. 724
29	29. 164	29. 147	29. 134	29. 148	69	78	72	74	85	77	78. 7	86	71	. 641	. 863	. 718	. 741
30	29. 178	29. 207	29. 238	29. 208	69	71	68	73	80	74	75. 7	80	69	. 655	. 637	. 604	. 632
31	29. 295	29. 332	29. 248	29. 292	63	70	66	67	80	72	73. 0	81	63	. 522	. 598	. 559	. 560
Means....	29. 353	29. 338	29. 313	29. 335	....	....	....	70. 5	83. 2	75. 2	76. 3	....	....	. 614	. 718	. 697	. 676
August 1	29. 635	29. 092	29. 117	29. 281	65	74	70	79	75	75	73. 0	82	68	. 431	. 826	. 666	. 641
2	29. 175	29. 261	29. 265	29. 234	64	64	66	69	70	70	69. 7	76	65	. 529	. 516	. 586	. 544
3	29. 371	29. 340	29. 223	29. 311	60	70	68	64	80	72	72. 0	81	64	. 465	. 598	. 631	. 565
4	29. 181	29. 315	29. 391	29. 296	60	65	62	64	71	66	67. 0	75	63	. 465	. 537	. 502	. 501
5	29. 433	29. 445	29. 395	29. 424	62	70	66	67	78	70	71. 7	77	65	. 489	. 625	. 586	. 533
6	29. 473	29. 473	29. 438	29. 461	62	70	65	66	78	69	71. 0	78	62	. 502	. 625	. 564	. 564
7	29. 443	29. 405	29. 371	29. 406	62	68	63	66	76	68	70. 0	77	61	. 502	. 577	. 509	. 529
8	29. 303	29. 137	28. 932	29. 124	62	66	71	66	71	74	70. 3	74	64	. 502	. 572	. 718	. 597
9	29. 171	29. 291	29. 283	29. 248	62	65	62	64	71	67	67. 3	75	62	. 529	. 537	. 489	. 518
10	29. 353	29. 435	29. 485	29. 424	62	68	64	66	74	68	69. 3	73	63	. 502	. 604	. 543	. 550
11	29. 466	29. 505	29. 471	29. 481	61	65	66	63	71	70	68. 0	72	60	. 510	. 537	. 586	. 544
12	29. 416	29. 283	29. 258	29. 319	65	70	71	66	74	75	71. 7	75	65	. 604	. 679	. 704	. 662
13	29. 135	29. 134	29. 117	20. 129	69	75	72	72	79	76	75. 7	79	65	. 668	. 814	. 731	. 738
14	29. 215	29. 228	29. 213	29. 219	66	68	67	69	73	70	70. 7	75	68	. 599	. 618	. 622	. 613
15	29. 368	29. 433	29. 506	29. 436	65	65	60	69	70	63	67. 3	72	63	. 564	. 550	. 478	. 531
16	29. 556	29. 593	29. 581	29. 577	57	61	56	60	67	59	62. 0	67	57	. 426	. 457	. 409	. 431
17	29. 459	29. 506	29. 466	29. 477	53	63	60	56	70	63	63. 0	72	47	. 363	. 482	. 478	. 441
18	29. 421	29. 348	29. 250	29. 340	59	70	67	62	76	70	69. 3	77	53	. 460	. 652	. 622	. 578
19	29. 145	29. 121	29. 183	29. 150	64	64	62	67	69	65	67. 0	72	65	. 556	. 529	. 516	. 534
20	29. 263	29. 251	29. 223	29. 246	60	60	61	64	70	64	66. 0	71	62	. 465	. 385	. 497	. 449
21	29. 211	29. 191	29. 120	29. 174	58	65	62	61	71	64	65. 3	72	59	. 443	. 537	. 529	. 503
22	29. 298	29. 231	29. 216	29. 248	59	63	56	61	67	59	62. 3	68	59	. 423	. 522	. 409	. 468
23	29. 244	29. 155	29. 212	29. 204	52	60	54	55	66	59	60. 0	66	53	. 349	. 438	. 351	. 379
24	29. 250	29. 272	29. 294	29. 272	49	52	52	51	56	55	54. 0	60	50	. 321	. 335	. 349	. 335
25	29. 357	29. 346	29. 293	29. 332	50	60	54	52	65	57	58. 0	65	50	. 334	. 451	. 378	. 388
26	29. 204	29. 246	29. 241	29. 260	56	62	61	58	70	64	64. 0	70	52	. 422	. 449	. 497	. 456
27	29. 269	29. 245	29. 236	29. 250	52	71	63	55	75	66	65. 3	75	53	. 349	. 704	. 536	. 530
28	29. 224	29. 231	29. 208	29. 221	57	66	61	60	70	64	64. 7	72	58	. 426	. 586	. 497	. 503
29	29. 276	29. 393	29. 271	29. 313	54	64	59	61	67	62	63. 3	69	53	. 443	. 556	. 460	. 486
30	29. 272	29. 238	29. 188	29. 233	53	62	64	55	65	67	62. 3	67	53	. 376	. 516	. 556	. 483
31	29. 298	29. 177	29. 168	29. 214	62	71	68	65	77	72	71. 3	78	63	. 516	. 678	. 631	. 608
Means....	29. 322	29. 301	29. 278	29. 300	....	....	....	63. 0	71. 3	66. 5	66. 9	....	....	. 470	. 564	. 536	. 523

the northern and northwestern lakes at Cleveland, Ohio.

VAPOR.				WIND.								Amount of cloudiness. (0 = clear sky.) (10 = sky entirely overcast.)			Amount of evaporation, in U. S. inches and decimals.	Amount of rain or melted snow, in U. S. inches and decimals.
Humidity. Saturation = 1,000.				Direction. From whence.			Velocity, in miles, per hour.			Resultant velocity, in miles, per hour.	Resultant direction.					
7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.		°	7 a. m.	2 p. m.	9 p. m.		
.884	.542	.804	.743	S	N	Calm	2	2	0	0	Calm	2	10	10	......	......
.841	.640	.768	.750	SE	S.SW	S.SE	2	12	2	5.0	S 8 W	7	8	4	......	......
.786	.524	.843	.718	S	S	S	4	12	12	9.3	South	3	10	2	......	......
.946	.782	.582	.770	SW	W	SE	12	2	2	4.3	S. 44 W.	3	2	0	......	.51
.850	.592	.824	.755	S.SW	W.SW.	SE	4	4	2	2.7	S. 28 W.	6	3	0	......	.02
.819	.601	.858	.759	S SW	SW	S	4	12	4	6.3	S. 32 W.	2	5	0	......	......
.856	.863	.854	.858	S	S	S	2	12	2	5.3	South	6	10	6	......	.22
.900	.824	.856	.860	SW	W.SW.	S	4	4	2	3.0	S. 46 W.	10	6	10	......	1.46
.841	.848	.833	.841	NE	NE	SE	4	4	2	3.0	N. 62 E.	5	6	0	......	......
.822	.768	.846	.812	SE	NE	Calm	2	4	0	1.7	N. 74 E.	0	2	0	......	......
.833	.784	.850	.822	SE	NE	Calm	2	4	0	1.7	N. 74 E.	5	0	0	......	......
.836	.681	.860	.792	SW	NW	SE	2	12	2	3.3	N. 56 W.	0	0	0	......	......
.850	.667	.789	.769	SW	NW	S	2	12	2	3.7	N. 62 W.	0	3	0	......	......
.741	.641	.792	.725	S.SW	W	S	2	12	2	4.5	S. 73 W.	5	2	0	......	......
.771	.561	.758	.697	S	W	S	2	12	2	4.3	S. 72 W.	0	0	0	......	......
.734	.590	.797	.707	S	W	SE	2	4	2	1.3	S. 38 W.	0	4	2	......	......
.711	.707	.734	.717	SW	SW	SE	4	12	2	5.3	S. 37 W.	6	7	3	......	......
.776	.688	.807	.757	SW	W	NE	12	12	25	3.3	N. 16 W.	7	9	10	......	.01
.799	.634	.751	.728	E. NE	NE	E. NE	4	12	2	6.0	N. 53 E.	6	10	10	......	.06
.790	.804	.758	.784	SE	NE	S	2	4	2	1.3	S. 81 E.	10	10	6	......	.23
.802	.768	.858	.809	W	N	W	2	2	2	1.7	N. 67 E.	5	6	0	......	.03
.850	.714	.779	.781	E	W.NW	Calm	2	4	0	0.7	N. 47 W.	0	3	0	......	1.04
.807	.807	.697	.770	NE	N	S	4	4	2	1.7	N. 31 E.	10	0	0	......	......
.790	.669	.810	.756	S	N	S	2	4	2	....	....	0	0	0	......	......
.843	.753	.731	.776	Calm	N	NE	0	2	12	4.7	N. 39 E.	7	2	0	......	......
.836	.600	.812	.749	S	N	S	2	4	4	0.7	South	0	7	10	......	......
.768	.652	.731	.717	W.SW	N	S	2	4	2	0.7	N. 52 W.	0	3	0	......	......
.893	.753	.734	.793	Calm	NE	Calm	0	4	0	1.3	N. 45 E.	0	5	3	......	......
.764	.718	.774	.752	NW	N	Calm	2	2	0	1.3	N. 21 W.	5	3	3	......	......
.807	.623	.720	.717	N	N	N	2	4	25	10.3	North	4	3	0	......	.08
.790	.585	.712	.696	Calm	NW	SE	0	2	4	0.7	S. 45 E.	0	0	6	......	......
.817	.690	.785	.764	....	....	....	....	....	....	6.3	S. 59 W.	3.7	4.5	2.7	......	3.66
.434	.952	.768	.718	S	W	W	4	25	35	20.3	S. 86 W.	10	5	3	......	.04
.747	.704	.799	.750	W.NW	NW	W.NW	25	25	25	24.3	N. 60 W.	4	8	3	......	.09
.780	.585	.804	.723	W	SW	SE	2	12	2	4.7	S. 45 W.	0	6	10	......	......
.780	.708	.786	.758	N	N	N	25	12	35	24.0	North	7	4	0	......	.58
.740	.653	.799	.731	N	W.NW	Calm	25	4	0	9.0	N. 8 W.	0	3	0	......	......
.786	.653	.796	.745	NW	NW	NW	4	12	2	6.0	N. 45 W.	0	5	0	......	......
.786	.644	.743	.724	S	W.NW	S	2	12	2	3.7	N. 87 W.	3	10	10	......	......
.786	.754	.856	.799	SE	SE	S	2	4	25	10.0	S. 8 E.	10	10	1	......	......
.888	.708	.740	.779	N.NW.	NW	S	35	12	2	14.7	N. 29 W.	10	3	3	......	.11
.786	.720	.793	.766	N	N	S	4	2	2	1.3	North	6	5	0	......	.13
.886	.708	.799	.798	S	NW	S	4	4	2	1.3	S. 38 W.	8	10	10	......	......
.945	.810	.812	.856	SE	W	SE	4	2	2	1.7	S. 32 E.	10	8	10	......	.30
.852	.822	.815	.830	SE	SW	N	2	2	2	0.3	South	10	4	0	......	.16
.846	.761	.848	.818	N	W.NW	W	4	4	4	3.0	N. 52 W.	10	10	10	......	......
.796	.751	.831	.793	E.NE	N. NE	SW	12	12	2	6.7	N. 45 E.	7	....	....	......	......
.822	.690	.819	.777	NE	E. NE	N	4	4	2	3.0	N. 45 E.	4	....	....	......	......
.809	.658	.831	.766	S	NE	E	4	4	4	2.3	S. 80 E.	....	....	....	......	......
.828	.727	.848	.801	SW	NE	NE	4	4	4	1.3	N. 45 E.	....	....	....	......	......
.841	.747	.836	.808	NE	NE	NE	2	12	2	5.3	N. 45 E.	....	....	....	......	......
.780	.525	.833	.713	E.NE	E. NE	W.SW.	4	4	4	1.3	N. 68 E.	....	....	....	......	......
.825	.708	.888	.807	W.SW.	W.SW.	S	12	12	2	8.3	S. 63 W.	10	5	0	......	......
.882	.790	.819	.830	W. NW	NW	S	25	4	4	9.0	N. 72 W.	9	9	7	......	.07
.805	.685	.703	.731	SE	W	W	2	12	25	11.7	S. 87 W.	7	9	6	......	.01
.859	.747	.805	.804	SW	W	W	12	25	4	12.7	S. 77 W.	6	5	10	......	.07
.861	.731	.812	.801	SW.W.	W	S	12	4	2	5.7	S. 61 W.	3	7	4	......	1.93
.876	.613	.833	.807	SW	W	S	4	12	2	5.0	S. 72 W.	0	3	0	......	......
.805	.812	.838	.818	S.SE	NW	S	4	4	2	1.0	S. 26 W.	4	6	3	......	......
.822	.799	.833	.818	E.SE	N	SE	2	2	2	1.0	S. 80 E.	9	7	0	......	......
.825	.841	.828	.831	SE	N	SE	2	4	2	1.0	N. 67 E.	10	6	0	......	......
.869	.836	.841	.849	SE	SE	SE	4	4	4	4.0	S. 45 E.	9	10	10	......	.18
.836	.731	.804	.790	SE	SE	SE	2	2	4	2.7	S. 45 E.	10	7	8	......	.01
.812	.728	.813	.784	....	....	....	....	....	....	3.3	N. 64 W.	6.5	6.8	4.5	......	3.68

Reductions of the monthly meteorological register of the survey of

Date.	Barometer reduced to temperature of 32° Fahr., expressed in United States inches and decimals.				TEMPERATURE—FAHRENHEIT.									VAPOR.			
					Wet bulb, or point of evaporation.			Dry bulb, or temperature of the open air.				Maximum.	Minimum.	Elasticity, in U. S. inches and decimals.			
	7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	Mean.			7 a. m.	2 p. m.	9 p. m.	Mean.
1866.					°	°	°	°	°	°	°	°	°				
Sept. 1	29.110	29.174	29.074	29.119	70	77	71	73	85	75	77.7	85	69	.693	.819	.704	.739
2	29.194	29.149	29.278	29.208	72	73	65	75	78	70	74.3	79	70	.744	.744	.550	.679
3	29.353	29.328	29.325	29.335	60	67	63	63	70	67	66.7	71	62	.478	.622	.522	.541
4	29.293	29.228	29.170	29.230	52	72	70	61	80	74	71.7	80	57	.269	.677	.679	.542
5	29.281	29.341	29.383	29.335	66	66	60	69	71	62	67.3	75	62	.599	.572	.491	.554
6	29.429	29.411	29.388	29.409	51	69	61	54	73	65	64.0	75	55	.335	.655	.483	.491
7	29.221	29.083	29.130	29.145	58	60	60	61	63	62	62.0	66	60	.443	.478	.491	.471
8	29.266	29.346	29.401	29.338	57	64	60	60	68	62	63.3	69	58	.426	.543	.491	.487
9	29.574	29.583	29.571	29.576	55	65	58	57	69	61	62.3	69	55	.407	.564	.443	.471
10	29.534	29.396	29.336	29.422	52	65	62	55	69	65	63.0	70	52	.349	.564	.516	.476
11	29.038	29.095	29.000	29.044	65	68	62	68	72	65	68.3	73	63	.577	.631	.516	.575
12	29.060	29.080	29.175	29.105	59	65	62	62	70	65	65.7	72	62	.460	.550	.516	.509
13	29.334	29.384	29.369	29.362	52	57	56	55	63	60	59.3	66	53	.349	.386	.396	.377
14	29.294	29.236	29.459	29.330	53	62	55	56	70	58	61.3	70	54	.363	.449	.393	.402
15	29.620	29.664	29.538	29.607	46	52	50	51	59	52	54.0	65	48	.245	.296	.273	.271
16	29.385	29.371	29.165	29.307	51	68	70	55	72	73	66.7	75	52	.321	.631	.693	.548
17	29.276	29.348	29.326	29.317	66	59	56	69	61	59	63.0	74	59	.599	.473	.409	.494
18	29.256	29.208	29.168	29.211	51	51	54	53	56	57	55.3	59	53	.348	.308	.378	.345
19	29.158	29.277	29.367	29.267	55	52	51	57	55	54	55.3	62	54	.407	.349	.335	.364
20	29.196	29.101	29.053	29.117	50	55	58	52	59	61	57.3	62	52	.334	.380	.443	.386
21	29.205	29.365	29.403	29.324	58	43	47	50	52	49	50.3	61	49	.309	.160	.297	.255
22	29.501	29.507	29.490	29.499	40	50	46	42	54	49	48.3	56	46	.221	.308	.271	.267
23	29.420	29.434	29.400	29.418	45	60	53	47	64	56	55.7	65	43	.273	.465	.363	.367
24	29.387	29.336	29.376	29.366	48	62	63	50	65	65	60.0	66	49	.309	.516	.549	.458
25	29.319	29.306	29.354	29.326	60	65	52	63	68	54	55.0	68	54	.478	.577	.362	.472
26	29.425	29.507	29.470	29.467	50	51	48	52	55	50	52.3	60	50	.334	.321	.309	.321
27	29.450	29.539	29.524	29.504	41	62	54	45	66	57	56.0	68	43	.205	.502	.378	.362
28	29.612	29.558	29.544	29.571	48	64	55	50	68	59	59.0	69	49	.309	.543	.380	.411
29	29.557	29.531	29.491	29.526	46	60	55	49	64	58	57.0	66	49	.271	.465	.393	.376
30	29.490	29.496	29.466	29.484	50	62	60	52	66	62	60.0	67	48	.334	.502	.491	.442
Means....	29.341	29.346	29.340	29.342	....	....	....	56.8	66.2	10.9	61.3	....	....	.393	.502	.450	.448
Oct. 1	29.404	29.474	29.431	29.436	55	60	59	58	65	61	61.3	68	57	.393	.451	.473	.439
2	29.314	29.251	29.256	29.274	52	69	62	55	73	65	64.3	74	53	.349	.655	.516	.507
3	29.374	29.374	29.382	29.377	49	49	44	52	53	46	50.4	65	46	.308	.295	.268	.288
4	29.525	29.554	29.679	29.586	42	49	43	44	53	46	47.7	62	42	.241	.295	.238	.258
5	29.778	29.758	29.736	29.757	37	48	45	39	56	48	47.0	60	27	.194	.230	.260	.228
6	29.725	29.675	29.623	29.674	40	58	55	42	64	58	54.7	65	41	.221	.403	.393	.339
7	29.639	29.577	29.478	29.565	57	65	59	60	70	62	64.0	71	57	.426	.550	.460	.479
8	29.512	29.446	29.376	29.445	55	65	61	57	71	64	64.0	72	56	.407	.537	.497	.480
9	29.359	29.284	29.158	29.267	58	59	55	60	62	58	60.0	66	58	.456	.460	.393	.436
10	29.197	29.253	29.351	29.267	53	57	54	55	60	58	57.7	61	54	.376	.426	.365	.389
11	29.314	29.314	29.326	29.318	55	58	55	57	62	59	59.3	62	54	.407	.429	.380	.405
12	29.494	29.271	29.301	29.355	55	59	52	57	62	55	58.0	62	52	.407	.460	.349	.405
13	29.402	29.461	29.494	29.452	53	55	54	54	58	57	56.3	58	52	.389	.393	.378	.387
14	29.589	29.594	29.670	29.618	52	54	49	55	59	51	55.0	60	51	.349	.351	.321	.340
15	29.770	29.768	29.774	29.771	41	58	50	43	62	52	52.3	62	42	.231	.429	.334	.331
16	29.737	29.722	29.627	29.695	45	62	52	47	65	54	55.3	66	45	.273	.516	.362	.384
17	29.550	29.499	29.461	29.503	43	63	52	45	67	55	55.7	67	45	.251	.522	.349	.374
18	29.480	29.426	29.398	29.435	45	61	55	47	69	59	58.3	71	45	.273	.430	.380	.361
19	29.397	29.414	29.423	29.411	51	62	62	54	71	65	63.3	71	52	.335	.436	.516	.429
20	29.509	29.458	29.413	29.460	59	65	61	62	75	65	67.3	75	60	.460	.483	.483	.475
21	29.306	29.191	29.192	29.230	59	64	60	62	73	60	65.0	73	60	.460	.476	.518	.485
22	29.111	29.219	29.260	29.197	54	52	49	57	62	52	57.0	68	52	.378	.256	.308	.314
23	29.238	29.207	29.291	29.245	41	45	39	45	54	41	46.7	60	41	.205	.181	.212	.199
24	29.358	29.322	29.464	29.381	35	40	38	39	43	40	40.7	51	34	.152	.208	.203	.188
25	29.546	29.479	29.423	29.483	37	43	40	40	46	42	42.7	47	34	.181	.238	.221	.213
26	29.301	29.270	29.341	29.304	36	44	40	39	46	43	42.7	47	37	.173	.262	.208	.214
27	29.524	29.537	29.545	29.535	35	43	41	38	47	43	42.7	48	37	.165	.225	.231	.207
28	29.408	29.275	29.240	29.308	43	60	56	46	63	60	56.3	64	42	.238	.478	.396	.371
29	29.159	29.161	29.144	29.155	50	47	44	52	50	46	49.3	62	46	.334	.283	.262	.293
30	29.164	29.154	29.238	29.185	41	40	35	43	43	37	41.3	55	37	.231	.208	.178	.206
31	29.434	29.474	29.504	29.471	36	38	35	39	41	38	39.3	48	35	.173	.190	.165	.176
Means....	29.439	29.415	29.419	29.424	....	....	....	49.8	59.5	52.9	54.1	....	....	.304	.379	.342	.342

the northern and northwestern lakes at Cleveland, Ohio.

VAPOR.				WIND.								Amount of cloudiness. (0 = clear sky.) (10 = sky entirely overcast.)			Amount of evaporation, in U. S. inches and decimals.	Amount of rain or melted snow, in U. S. inches and decimals.
Humidity. Saturation = 1,000.				Direction. From whence.			Velocity, in miles, per hour.			Resultant velocity, in miles, per hour.	Resultant direction.					
7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.		°	7 a. m.	2 p. m.	9 p. m.		
.854	.681	.812	.782	S	S	S	12	12	4	9.3	South	4	5	10	......	......
.858	.776	.751	.795	SW	W.NW	S	4	4	2	2.3	S. 62 W.	5	6	0	......	.02
.831	.848	.790	.823	SE	N	S	2	2	2	0.7	S. 45 E.	10	10	0	......	......
.502	.661	.810	.658	S	S	S	2	12	2	5.3	South	0	5	0	......	.01
.846	.754	.884	.828	W.NW	W.by N	S	25	4	2	9.7	N. 73 W.	10	3	0	......	......
.802	.807	.783	.797	S	N	SE	2	2	2	0.7	S. 45 E.	3	0	2	......	.03
.825	.831	.884	.847	NE	NE	NE	4	25	4	11.0	N. 45 E.	10	10	10	......	.07
.822	.793	.884	.833	N.NE	W.NW	W.NW	4	12	35	15.7	N. 63 W.	10	3	10	......	1.51
.874	.796	.825	.832	NW	NW	SE	2	4	4	0.7	N. 45 W.	4	6	0	......	.29
.805	.796	.836	.812	S	S	S	12	12	2	8.7	South	10	8	10	......	......
.843	.804	.836	.828	S	W	W	2	2	13	5.3	S. 82 W.	10	10	10	......	.30
.828	.751	.836	.805	W	W	W	25	35	4	21.3	West	8	5	0	......	.36
.805	.670	.765	.747	W	W	W	4	35	25	21.3	West	2	10	10	......	......
.809	.613	.816	.746	S	W	W	2	25	35	20.0	S. 88 W.	10	6	2	......	......
.653	.592	.847	.697	N	NW	S	4	4	2	1.7	N. 34 W.	0	5	10	......	......
.743	.804	.854	.800	S	NW	S	12	4	25	11.7	S. 4 W.	7	6	7	......	......
.846	.882	.819	.849	SE	NE	NE	4	12	2	5.0	N. 58 E.	10	10	10	......	.12
.864	.687	.812	.788	SE	NE	NE	2	2	2	1.7	N. 74 E.	10	10	10	......	.57
.874	.805	.802	.827	NE	NE	NE	35	12	12	19.7	N. 45 E.	10	10	10	......	1.34
.861	.761	.825	.816	NE	E	NE	2	2	2	1.7	N. 56 E.	10	10	10	......	.10
.856	.411	.853	.707	NW	NW	NW	25	12	4	13.7	N. 45 E.	10	9	6	......	.32
.829	.738	.781	.783	S	SE	SE	4	2	4	2.3	S. 39 E.	10	10	0	......	......
.847	.780	.809	.812	SE	SW	S	4	2	2	2.3	S. 11 E.	0	6	0	......	......
.856	.836	.890	.861	S	S	S	12	12	2	8.7	South	0	0	10	......	......
.831	.843	.867	.847	SE	NE	N	4	12	35	14.3	N. 16 E.	10	10	10	......	.20
.861	.743	.856	.820	N	NW	SE	25	2	2	8.3	North	10	3	0	......	1.46
.684	.786	.812	.761	S	W.NW	SE	2	2	2	1.0	S. 11 W.	0	0	0	......	......
.856	.793	.761	.803	SE	NE	SE	2	2	2	1.7	S. 74 E.	0	0	0	......	......
.781	.780	.816	.792	SE	NE	SE	2	4	2	1.9	East	0	4	0	......	......
.861	.786	.884	.844	N	Calm	SE	2	0	2	0.7	N. 72 E.	0	6	0	......	......
.813	.754	.827	.798	......	......	......	......	......	......	2.3	N. 75 W.	6.1	6.2	4.9	......	6.70
.816	.731	.882	.810	N	N	SE	2	2	2	1.0	S. 28 E.	0	0	0	......	......
.805	.807	.836	.816	S	W	N	2	2	25	8.0	N. 5 W.	0	3	4	......	......
.794	.733	.843	.790	N	N	SE	12	4	2	5.0	N. 6 E.	7	9	0	......	......
.836	.733	.767	.779	SE	N	S	2	4	2	0.7	N. 72 E.	10	3	3	......	......
.816	.512	.777	.702	SE	S	S	25	4	2	9.7	S. 37 E.	0	0	0	......	......
.829	.675	.816	.773	S	N	S	4	2	2	1.3	South	0	0	0	......	......
.822	.751	.828	.800	SW	W	S	2	2	2	1.3	S. 45 W.	6	3	0	......	......
.874	.708	.833	.805	S	N	S	2	2	2	0.7	South	2	4	0	......	......
.880	.828	.816	.841	N	SE	SE	4	12	25	11.7	S. 50 E.	10	10	10	......	......
.869	.822	.756	.816	SE	S	S	2	4	2	2.7	S. 10 E.	10	10	10	......	2.01
.874	.772	.761	.792	NE	NE	NE	2	4	4	3.3	N. 45 E	10	6	6	......	......
.874	.828	.805	.836	NE	NE	NE	4	25	2	10.3	N. 45 E.	7	2	0	......	......
.933	.816	.812	.854	NE	NE	NE	4	12	12	9.3	N. 45 E.	6	8	4	......	......
.805	.703	.859	.789	NE	NE	NE	2	25	2	9.7	N. 45 E.	6	0	0	......	......
.833	.772	.861	.822	SE	NE	SE	2	2	2	1.7	S. 74 E.	0	0	0	......	......
.847	.836	.867	.850	SE	N	SE	2	4	2	1.0	N. 67 E.	0	0	0	......	......
.840	.790	.805	.812	S	W	S	2	2	2	1.3	S. 24 W.	0	0	0	......	......
.847	.607	.761	.738	SE	S	SE	4	2	2	2.6	S. 30 E	0	0	3	......	......
.802	.576	.836	.738	SW	SW	S	4	4	2	3.0	S. 36 W.	6	7	3	......	......
.828	.558	.783	.723	S	S	S	2	12	2	5.3	South	10	4	3	......	......
.828	.568	1.000	.805	S	SW	S	25	25	35	26.3	S. 13 W.	6	7	10	......	......
.812	.461	.794	.689	SW	SW	SW	45	12	4	20.3	S. 45 W.	7	0	0	......	......
.684	.434	.824	.647	SW	W.SW.	W	12	25	35	23.0	S. 74 W.	5	7	10	......	......
.636	.750	.820	.735	NW	NW	NW	35	25	12	24.0	N. 45 W.	6	10	9	......	.26
.732	.767	.829	.776	SW	SE	SE	4	2	2	1.9	South	10	10	10	......	......
.726	.843	.750	.773	S	SW	W	12	4	25	10.3	S. 26 W.	10	9	10	......	.12
.719	.698	.833	.750	S	W.NW	S	12	4	2	4.3	S. 16 W.	10	6	10	......	.03
.767	.831	.765	.788	S.SE	S	S	12	25	35	24.0	S. 4 E.	5	6	10	......	.07
.861	.786	.843	.830	S	NW	NW	12	4	12	3.7	S. 86 W.	10	10	10	......	.17
.833	.750	.807	.797	SW	W	W.NW	4	12	35	16.3	N. 78 W.	10	10	10	......	.36
.726	.738	.719	.728	W.NW	W	SW	35	25	4	20.3	N. 80 W.	10	10	10	......	.38
.811	.716	.816	.781	......	......	......	......	......	......	2.8	S. 51 W.	5.8	5.0	4.5	......	3.40

Reductions of the monthly meteorological register of the survey of

Date.	Barometer reduced to temperature of 32° Fahr., expressed in United States inches and decimals.				TEMPERATURE—FAHRENHEIT.									VAPOR.			
					Wet bulb, or point of evaporation.			Dry bulb, or temperature of the open air.				Maximum.	Minimum.	Elasticity, in U.S. inches and decimals.			
	7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	Mean.			7 a. m.	2 p. m.	9 p. m.	Mean.
1866.					°	°	°	°	°	°	°	°	°				
Nov. 1	29.452	29.230	29.186	29.289	36	48	47	39	52	49	46.7	52	34	.173	.282	.297	.251
2	29.403	29.503	29.561	29.489	47	49	43	49	52	45	48.7	52	43	.297	.308	.251	.285
3	29.678	29.672	29.641	29.664	40	40	39	42	43	41	42.0	43	41	.221	.208	.212	.214
4	29.756	29.758	29.831	29.782	44	40	39	47	44	41	44.0	50	34	.249	.195	.212	.219
5	29.965	29.989	30.022	29.992	36	39	32	38	41	32	37.0	47	34	.186	.212	.181	.193
6	29.959	29.841	29.800	29.867	34	48	37	37	51	39	42.3	52	27	.157	.296	.194	.216
7	29.669	29.602	29.520	29.597	31	51	42	33	59	46	46.0	61	32	.151	.269	.215	.212
8	29.468	29.406	29.434	29.436	36	54	50	39	57	54	50.0	58	37	.173	.378	.308	.286
9	29.533	29.476	29.484	29.498	45	52	48	58	10	51	53.1	62	47	.260	.282	.296	.279
10	29.483	29.346	29.129	29.319	33	47	45	36	52	48	45.3	57	35	.149	.257	.260	.222
11	29.106	29.186	29.353	29.215	41	44	40	44	49	43	45.3	54	43	.218	.223	.208	.216
12	29.496	29.564	29.621	29.560	40	41	35	43	45	37	41.7	51	31	.208	.205	.178	.197
13	29.674	29.597	29.575	29.615	28	40	41	30	50	44	41.3	51	29	.130	.117	.218	.155
14	29.358	29.328	29.311	29.332	41	50	46	46	53	49	49.3	53	43	.193	.321	.271	.261
15	29.077	28.858	28.879	28.938	42	44	37	44	47	39	43.3	50	39	.241	.249	.194	.228
16	29.808	28.637	28.977	28.874	32	35	38	34	39	41	38.0	45	33	.155	.152	.190	.166
17	29.197	29.230	29.266	29.231	38	40	36	41	44	38	41.0	45	38	.190	.195	.186	.190
18	29.246	29.223	29.204	29.224	35	45	44	38	50	47	45.0	51	36	.165	.234	.249	.216
19	29.009	28.884	28.854	28.916	43	45	45	45	48	47	46.7	48	44	.251	.260	.273	.261
20	29.052	29.047	29.192	29.097	41	43	40	44	46	42	44.0	48	42	.218	.238	.221	.226
21	29.319	29.318	29.286	29.306	35	39	34	38	42	36	38.7	45	36	.165	.199	.170	.178
22	28.937	28.982	29.197	29.039	35	34	33	37	37	35	36.3	44	34	.178	.157	.162	.166
23	29.360	29.364	29.404	29.376	31	31	30	33	34	32	33.0	37	32	.151	.139	.144	.145
24	29.475	29.478	29.456	29.470	30	34	32	32	38	35	35.0	40	32	.144	.144	.142	.143
25	29.562	29.570	29.487	29.540	31	37	30	33	40	32	35.0	41	30	.151	.181	.144	.159
26	29.455	29.417	29.403	29.425	28	47	40	30	51	42	41.0	51	29	.130	.270	.221	.207
27	29.406	29.307	29.260	29.324	35	50	50	38	54	53	48.3	54	36	.165	.308	.321	.265
28	29.121	28.983	29.063	29.056	54	55	49	55	59	51	55.0	59	51	.404	.380	.321	.368
29	29.064	29.091	29.159	29.105	40	36	33	42	39	35	38.7	51	35	.221	.173	.162	.185
30	29.270	29.353	29.418	29.347	27	26	28	29	30	30	29.7	47	29	.124	.095	.130	.116
Means....	29.378	29.348	29.366	29.364	....	....	....	39.5	46.9	41.8	42.7	....	....	.194	.231	.218	.214
Dec. 1	29.525	29.538	29.519	29.527	28	27	28	29	30	30	29.7	34	29	.142	.113	.130	.128
2	29.550	29.469	29.464	29.494	23	38	31	24	42	33	33.0	42	23	.112	.177	.151	.147
3	29.367	29.179	29.181	29.242	30	41	40	33	46	42	40.3	47	33	.132	.192	.221	.182
4	28.985	29.111	29.310	29.135	38	44	38	40	48	40	42.7	49	39	.203	.236	.203	.214
5	29.536	29.548	29.574	29.553	32	42	38	34	45	41	40.0	46	34	.155	.228	.190	.191
6	29.537	29.384	29.411	29.444	39	42	43	41	44	46	43.7	47	31	.212	.241	.238	.221
7	29.484	29.262	29.210	29.352	42	47	46	45	52	49	48.7	52	45	.228	.257	.271	.252
8	28.740	28.795	29.081	28.872	52	45	33	55	50	36	47.0	57	36	.349	.234	.149	.241
9	29.195	29.146	29.156	29.166	23	26	17	25	29	19	24.3	36	19	.100	.106	.071	.092
10	29.261	29.306	29.395	29.321	11	16	12	12	18	14	14.7	20	12	.061	.067	.052	.060
11	29.401	29.328	29.356	29.362	12	21	19	13	23	20	18.7	25	12	.063	.090	.092	.082
12	29.441	29.527	29.562	29.510	11	13	12	12	14	13	13.0	20	12	.061	.067	.063	.064
13	29.574	29.472	29.428	29.491	15	20	18	16	22	20	19.3	23	13	.074	.085	.076	.078
14	29.696	29.740	29.775	29.737	19	19	15	20	21	16	19.0	23	16	.092	.080	.074	.082
15	29.723	29.610	29.368	29.567	4	18	19	5	20	20	15.0	23	5	.041	.087	.092	.073
16	28.958	28.853	28.867	28.893	27	30	30	29	33	32	31.3	35	22	.124	.132	.144	.133
17	29.125	29.278	29.463	29.289	27	24	24	28	26	26	26.7	33	26	.136	.106	.106	.116
18	29.608	29.514	29.468	29.530	31	28	27	33	29	28	30.0	34	23	.151	.142	.136	.143
19	29.450	29.474	29.486	29.470	28	31	30	30	34	31	31.7	34	29	.130	.139	.155	.141
20	29.804	29.866	29.851	29.840	13	20	4	14	21	5	13.3	32	5	.067	.096	.041	.068
21	29.763	29.590	29.520	29.624	2	19	23	3	21	23	15.7	30	2	.036	.080	.123	.080
22	29.343	29.182	29.092	29.206	29	35	37	30	37	39	35.3	40	19	.149	.178	.194	.174
23	28.790.	28.615	28.633	28.679	41	42	35	43	45	37	41.7	47	37	.244	.228	.178	.217
24	28.900	28.918	28.996	28.938	30	28	28	31	30	30	30.3	37	30	.155	.130	.130	.138
25	29.197	29.246	29.352	29.265	19	21	15	20	22	16	19.3	30	16	.092	.101	.074	.089
26	29.243	29.104	29.075	29.141	19	28	23	20	30	25	25.0	32	15	.092	.130	.100	.107
27	29.204	29.246	29.359	29.270	10	16	12	11	17	13	13.7	25	11	.057	.078	.063	.066
28	29.413	29.387	29.462	29.421	11	17	16	12	18	17	15.7	18	10	.061	.083	.078	.074
29	29.567	29.508	29.515	29.530	13	16	14	14	17	15	15.3	17	14	.067	.078	.071	.072
30	29.592	29.533	29.507	29.544	5	18	11	6	20	12	12.7	23	6	.043	.076	.061	.060
31	29.402	29.395	29.502	29.433	6	19	16	7	21	17	15.0	21	6	.046	.080	.078	.066
Means....	29.367	29.330	29.353	29.350	....	....	....	23.7	29.8	26.0	26.5	....	....	.119	.133	.120	.124

the northern and northwestern lakes at Cleveland, Ohio.

VAPOR.				WIND.								Amount of cloudiness. (0 = clear sky.) (10 = sky entirely overcast.)			Amount of evaporation, in U. S. inches and decimals.	Amount of rain or melted snow, in U. S. inches and decimals.
Humidity. Saturation = 1,000.				Direction. From whence.			Velocity, in miles, per hour.			Resultant velocity, in miles, per hour.	Resultant direction.					
7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.			7 a. m.	2 p. m.	9 p. m.		
.726	.727	.853	.769	S	S	S	25	25	35	28.3	South	10	2	0	......	......
.853	.794	.840	.829	N	W	NW	4	4	12	6.0	N. 45 W.	10	3	10	......	......
.829	.750	.824	.801	SW	W	S	2	2	2	1.7	S. 45 W.	10	10	6	......	......
.772	.677	.824	.758	SE	SE	NE	2	2	2	1.7	S. 74 E.	9	10	10	......	......
.811	.824	1.000	.878	NE	NE	NE	2	4	2	2.7	N. 45 E.	10	5	0	......	......
.712	.790	.816	.773	SE	NW	SE	2	2	2	0.7	S. 45 E.	0	0	0	......	......
.800	.537	.691	.676	SE	SW	SE	2	2	2	1.7	S. 16 E.	0	0	0	......	......
.726	.812	.738	.759	S	S	Calm	4	2	0	2.0	South	4	10	10	......	......
.777	.546	.790	.704	SW	W. SW	S	2	2	2	1.7	S. 37 W.	10	4	0	......	......
.705	.660	.777	.714	SE	SE	SE	4	2	25	10.3	S. 45 E.	4	10	10	......	......
.756	.638	.750	.715	SW	W	W. SW	12	25	25	19.7	S. 72 W.	10	3	10	......	.32
.750	.684	.807	.747	W	W. NW	S	2	4	2	2.0	S. 81 W.	10	8	0	......	......
.782	.322	.756	.620	SE	E	S	2	4	25	9.0	S. 12 E.	4	5	9	......	......
.617	.798	.781	.732	S	S	S	12	12	4	9.3	South	10	10	10	......	......
.836	.772	.816	.808	S	W	W	2	2	35	12.7	S. 87 W.	10	10	10	......	.57
.792	.636	.738	.722	W. SW	W	W	4	25	25	17.7	S. 88 W.	10	10	10	......	.33
.738	.677	.811	.742	W	W. SW	S	12	4	2	5.3	S. 77 W.	10	9	0	......	......
.719	.646	.772	.712	S	S	S	2	2	2	2.0	South	7	8	10	......	.02
.840	.777	.847	.821	SE	S	W	2	25	25	11.7	S. 41 W.	10	10	11	......	.07
.756	.767	.829	.784	NW	NW	NW	12	25	4	13.7	N. 45 W.	11	10	11	......	.31
.719	.744	.802	.755	W. NW	NW	S	12	12	2	7.3	N. 60 W.	10	9	10	......	......
.807	.712	.797	.772	S	SW	N	2	4	35	10.3	N. 5 W.	10	10	10	......	.11
.800	.712	.794	.769	NW	NW	NW	4	25	12	13.7	N. 45 W.	5	9	10	......	.20
.794	.628	.698	.707	NW	NW	NW	12	4	25	13.7	N. 45 W.	4	10	10	......	......
.800	.732	.794	.775	W. NW	W	S	4	2	2	2.0	S. 82 W.	10	4	0	......	......
.782	.722	.829	.778	SE	S. SE	S	2	4	2	2.7	S. 21 E.	0	3	0	......	......
.719	.738	.798	.752	S	S	S	2	4	4	3.3	South	3	7	10	......	......
.934	.761	.859	.851	SE	SE	SE	4	12	2	6.0	S. 45 E.	10	10	10	......	.14
.829	.726	.797	.784	W. NW	W. NW	S	2	4	4	2.0	S. 74 W.	10	10	10	......	.63
.775	.569	.782	.709	SW	SW	W. NW	12	25	25	5.7	S. 11 W.	10	10	10	......	......
.775	.696	.800	.757	....	....	....	....	....	....	3.4	S. 62 W.	7.7	7.3	6.8	......	2.70
.887	.675	.782	.781	SW	W	S	4	4	2	2.0	S. 42 W.	10	10	10	......	......
.868	.661	.800	.776	SW	S	S. SE	2	4	25	10.0	S. 16 E.	0	0	0	......	......
.703	.617	.829	.716	S	S	S	12	25	35	24.0	South	2	10	10	......	......
.820	.704	.820	.781	W	W	S	4	4	2	3.0	S. 77 W.	10	0	0	......	.29
.792	.762	.738	.764	SE	SE	SE	2	4	4	3.3	S. 45 E.	3	10	10	......	......
.824	.836	.767	.809	SE	SE	W. SW.	12	4	4	5.0	S. 31 E.	10	10	10	......	......
.762	.660	.781	.734	SW	SW	SW	2	4	12	6.0	S. 45 W.	10	3	4	......	.04
.805	.646	.705	.719	S. SW.	W. SW	W	35	35	45	33.7	S. 63 W.	10	7	10	......	.56
.746	.665	.692	.701	SW	SW	SW	4	25	35	21.3	S. 45 W.	0	10	10	......	......
.804	.682	.635	.707	SW	W. SW	W	12	12	4	9.0	S. 61 W.	10	7	10	......	......
.810	.730	.850	.797	W	W	W	4	25	35	21.3	West	6	10	10	......	......
.804	.816	.810	.810	SW	SW	SW	25	25	25	25.0	S. 45 W.	10	10	5	......	......
.829	.721	.702	.751	SW	SW	SW	2	2	4	2.7	S. 45 W.	10	10	10	......	......
.850	.712	.829	.797	NE	NE	NE	25	2	2	9.7	N. 45 E.	5	10	10	......	.13
.750	.845	.850	.815	S	N	E	2	2	4	1.3	East	0	10	10	......	......
.775	.703	.794	.757	SE	E. SE	E. NE.	2	4	2	2.3	S. 72 E.	10	10	10	......	.48
.883	.754	.754	.797	NW	W	SW	12	12	4	8.0	N. 76 W.	10	10	10	......	.34
.800	.887	.883	.857	S	S	S	2	4	12	6.0	South	5	10	10	......	......
.782	.712	.893	.796	S	W	W	2	2	25	9.3	S. 86 W.	10	10	0	......	......
.816	.855	.750	.807	SE	NE	SE	2	2	2	1.7	S. 74 E.	10	0	10	......	.08
.730	.712	1.000	.814	S	S	S	2	2	4	2.7	South	10	7	10	......	......
.890	.807	.816	.838	S	S	S	12	4	12	9.3	South	10	10	10	......	......
.914	.762	.807	.828	SE	S	W. SW	12	12	45	16.7	S. 42 W.	10	10	10	......	......
.893	.782	.782	.819	W	W	W	4	12	12	9.3	West	10	10	0	......	.79
.850	.860	.829	.846	SW	W	S	4	4	2	2.7	S. 55 W.	10	10	10	......	.06
.850	.782	.746	.793	S	S	W	4	2	45	15.3	S. 82 W.	6	10	10	......	......
.797	.834	.810	.814	NW	NW	SW	35	35	25	24.7	N. 65 W.	10	10	10	......	.30
.804	.840	.834	.826	W	W	W	35	25	35	31.7	West	10	4	10	......	.12
.816	.834	.823	.824	W	W	W	4	12	2	6.0	West	10	10	10	......	......
.760	.702	.804	.755	S	S	S	2	2	2	2.0	South	0	5	4	......	.03
.769	.712	.834	.772	S	SW	N	2	2	2	0.7	S. 45 W.	6	4	10	......	......
.841	.751	.798	.797	....	....	....	....	....	....	7.5	S. 58 W.	7.5	7.9	8.1	......	3.22

Reductions of the monthly meteorological register of the survey of

Date.	Barometer reduced to temperature of 32° Fahr., expressed in United States inches and decimals.				TEMPERATURE—FAHRENHEIT.									VAPOR.			
					Wet bulb, or point of evaporation.			Dry bulb, or temperature of the open air.				Maximum.	Minimum.	Elasticity, in U. S. inches and decimals.			
	7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	Mean.			7 a. m.	2 p. m.	9 p. m.	Mean.
1866.					°	°	°	°	°	°	°	°	°				
July 1	29.619	29.615	29.561	29.598	57	63	61	63	72	66	67.0	74	49	.386	.455	.470	.437
2	29.601	29.535	29.433	29.523	61	68	63	66	76	69	70.3	78	60	.470	.577	.495	.514
3	29.411	29.284	29.233	29.309	64	70	63	70	80	69	73.0	82	62	.516	.598	.495	.536
4	29.098	29.085	29.138	29.107	62	68	65	64	69	68	67.0	70	62	.529	.671	.577	.592
5	29.278	29.288	29.301	29.287	05	72	69	67	75	70	70.7	77	65	.591	.744	.695	.677
6	29.373	29.347	29.313	29.344	70	74	70	73	79	73	75.0	81	69	.693	.772	.693	.719
7	29.313	29.290	29.255	29.286	69	72	68	73	78	72	74.3	79	68	.655	.704	.631	.663
8	29.243	29.273	29.323	29.280	70	71	63	73	73	69	71.7	75	68	.693	.731	.495	.640
9	29.509	29.535	29.567	29.537	60	65	56	63	72	60	65.0	74	56	.478	.524	.396	.466
10	29.620	29.554	29.518	29.564	55	67	62	59	80	67	68.7	80	50	.380	.487	.489	.452
11	29.591	29.545	29.463	29.533	67	70	67	70	76	69	71.7	78	58	.622	.652	.635	.636
12	29.523	29.442	29.368	29.444	65	70	67	69	77	71	72.3	77	66	.564	.639	.608	.604
13	29.283	29.312	29.245	29.280	71	73	70	73	77	72	74.0	78	69	.731	.757	.706	.731
14	29.325	29.324	29.320	29.323	70	76	72	72	80	74	75.3	81	70	.706	.843	.757	.769
15	29.320	29.382	29.360	29.354	72	74	71	74	81	74	76.3	82	72	.757	.745	.718	.740
16	29.438	29.437	29.385	29.420	72	76	73	75	83	76	78.0	83	72	.744	.802	.771	.772
17	29.438	29.352	29.311	29.367	73	77	68	75	81	70	75.3	82	68	.784	.873	.658	.772
18	29.265	29.193	29.252	29.237	70	72	61	72	73	62	69.0	75	62	.706	.771	.523	.667
19	29.420	29.430	29.426	29.425	57	65	62	59	74	64	65.7	75	55	.439	.476	.529	.481
20	29.417	29.370	29.323	29.370	57	68	66	60	74	69	67.7	74	65	.426	.604	.599	.543
21	29.321	29.210	29.165	29.232	64	72	68	66	78	72	72.0	78	61	.569	.476	.631	.559
22	29.181	29.170	29.138	29.163	65	69	66	60	74	68	69.3	75	63	.604	.641	.612	.619
23	29.182	29.228	29.256	29.222	60	66	65	62	75	68	68.3	74	64	.491	.519	.577	.529
24	29.364	29.297	29.308	29.323	63	73	66	65	79	71	71.7	78	58	.549	.730	.572	.617
25	29.354	29.317	29.343	29.338	67	74	67	69	79	69	72.3	80	62	.635	.772	.635	.681
26	29.421	29.384	29.375	29.393	64	74	69	66	80	72	72.7	81	62	.569	.758	.668	.665
27	29.368	29.324	29.263	29.318	69	73	70	71	80	73	74.7	80	66	.682	.717	.693	.697
28	29.271	29.187	29.168	29.209	67	74	68	70	83	71	74.7	84	63	.622	.718	.644	.661
29	29.181	29.164	29.135	29.160	67	63	62	70	80	69	73.0	82	63	.622	.349	.462	.478
30	29.201	29.230	29.254	29.228	64	62	58	66	78	65	69.7	78	63	.569	.342	.389	.433
31	29.334	29.168	29.256	29.253	57	60	60	61	75	68	68.0	79	53	.412	.318	.411	.414
Means....	29.363	29.331	29.315	29.336	....	....	....	67.5	77.1	69.3	71.3	...	....	.587	.634	.588	.605
Aug. 1	29.128	29.067	29.065	29.087	62	69	70	64	72	73	69.7	75	63	.529	.668	.693	.630
2	29.083	29.190	29.222	29.165	60	62	57	66	67	62	65.0	74	61	.438	.489	.399	.442
3	29.370	29.333	29.294	29.332	54	65	63	59	73	65	65.7	73	52	.351	.510	.549	.470
4	29.161	29.234	29.294	29.230	58	59	59	59	61	61	60.3	68	58	.469	.473	.473	.472
5	29.367	29.346	29.349	29.354	57	58	59	60	68	63	63.7	69	54	.426	.350	.447	.408
6	29.399	29.383	29.379	29.387	59	61	55	63	73	63	66.3	75	54	.447	.376	.327	.383
7	29.427	29.375	29.361	29.388	56	65	62	60	72	66	66.0	74	54	.396	.524	.502	.474
8	29.372	29.193	29.093	29.219	57	63	58	58	73	62	64.3	77	53	.452	.442	.429	.441
9	29.059	29.188	29.234	29.160	55	65	56	56	71	61	62.7	71	56	.420	.537	.383	.447
10	29.495	29.395	29.389	29.426	55	63	59	57	72	63	64.0	72	56	.407	.455	.447	.436
11	29.405	29.480	29.466	29.450	55	65	59	57	74	64	65.0	74	53	.407	.497	.433	.449
12	29.489	29.385	29.291	29.388	59	68	63	63	76	66	68.3	78	56	.447	.577	.536	.520
13	29.193	29.145	29.110	29.149	66	73	70	69	76	71	72.0	77	65	.599	.771	.720	.697
14	29.204	29.220	29.233	29.219	64	69	67	65	74	69	69.3	76	63	.583	.641	.635	.820
15	29 414	29.471	29.525	29.470	61	64	54	65	70	57	64.0	71	57	.483	.516	.378	.459
16	29.635	29.606	29.480	29.574	49	56	48	53	64	55	57.3	65	51	.295	.343	.243	.294
17	29.570	29.521	29.431	29.507	50	60	59	55	70	66	63.7	70	46	.295	.385	.407	.362
18	29.432	29.363	29.244	29.346	57	67	63	62	73	66	67.7	75	61	.399	.581	.509	.496
19	29.161	29.138	29.138	29.146	61	58	58	63	60	60	61.0	69	59	.510	.456	.456	.474
20	29.267	29.276	29.222	29.255	53	59	53	56	68	58	60.7	70	53	.363	.380	.336	.360
21	29.192	29.163	29.131	29.162	55	58	57	58	66	63	62.8	70	55	.393	.376	.386	.385
22	29.119	29.178	29.210	29.169	53	54	53	56	64	55	58.3	66	55	.363	.285	.376	.341
23	29.149	29.206	29.136	29.164	50	56	50	52	64	53	56.3	65	51	.334	.343	.321	.333
24	29.241	29.254	29.275	29.257	48	55	49	51	61	53	55.0	62	49	.296	.354	.295	.315
25	29.373	29.356	29.310	29.346	50	55	50	54	64	55	57.7	65	48	.308	.314	.295	.306
26	29.287	29.241	29.206	29.245	54	60	59	56	66	64	62.0	68	53	.391	.438	.433	.421
27	29.264	29.265	29.249	29.259	58	62	61	61	72	63	65.3	73	62	.443	.422	.510	.458
28	29.274	29.235	29.204	29.238	56	67	63	61	72	65	66.0	72	57	.383	.595	.549	.509
29	29.267	29.271	29.259	29.266	59	61	60	60	70	63	64.3	71	61	.487	.416	.478	.460
30	29.302	29.423	29.224	29.316	57	63	61	58	69	65	64.0	72	54	.452	.495	.483	.477
31	29.299	29.261	29.246	29.269	61	63	65	63	70	68	67.0	76	62	.510	.482	.577	.523
Means....	29.303	29.295	29.267	29.288	....	....	....	59.3	69.2	62.6	63.7	....	....	.422	.467	.452	.447

the northern and northwestern lakes at Buffalo, New York.

VAPOR.				WIND.								Amount of cloudiness. (0=clear sky.) (10=sky entirely overcast.)			Amount of evaporation, in U. S. inches and decimals.	Amount of rain or melted snow, in U. S. inches and decimals.
Humidity. Saturation = 1,000.				Direction. From whence.			Velocity, in miles, per hour.			Resultant velocity, in miles, per hour.	Resultant direction.					
7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.			7 a. m.	2 p. m.	9 p. m.		
											°					
.670	.582	.735	.662	S. SW.	SW ...	N. NE.	2	12	2	4.0	S. 45 W.	1	4	8	......	......
.735	.644	.700	.693	S......	SW ...	SE....	2	4	2	2.3	S. 8 W.	10	10	6	......	......
.704	.585	.700	.663	SW ...	W.SW.	NW ...	4	4	12	5.0	N. 71 W.	10	9	4	......	......
.888	.947	.843	.893	S......	W.SW.	W.SW.	4	35	25	20.7	S. 64 W.	10	3	10	......	.28
.893	.858	.948	.900	SW ...	S......	SE....	4	4	2	3.0	S. 7 W.	10	9	3	......	.18
.854	.779	.854	.829	W.SW.	W.SW.	W.SW.	4	25	12	13.3	S. 68 W.	10	1	0	......	......
.807	.734	.804	.782	SW ...	SW ...	W.SW.	12	25	4	13.0	S. 47 W.	3	8	6	......	......
.854	.902	.700	.819	W.SW.	W.SW.	NW ...	25	12	12	14.3	S. 83 W.	10	10	10	......	......
.831	.668	.765	.755	NE....	NE....	NE....	12	12	2	8.7	N. 45 E.	10	8	0	......	.12
.761	.476	.740	.659	E	NE....	N. NE.	4	4	4	3.7	N. 52 E.	0	2	2	......	......
.848	.727	.896	.824	W.SW.	W.SW.	W.SW.	2	12	4	6.0	S. 68 W.	8	2	0	......	......
.796	.689	.802	.762	W.SW.	W.SW.	W.SW.	12	25	12	16.3	S. 68 W.	4	0	0	......	......
.902	.817	.900	.873	W.SW.	W.SW.	W.....	25	25	25	24.7	S. 75 W.	0	4	10	......	......
.900	.824	.903	.876	SW ...	W.SW.	W.SW.	4	12	4	6.3	S. 65 W.	10	10	0	......	.08
.903	.704	.856	.821	W.SW.	W.SW.	W.SW.	4	25	12	13.3	S. 68 W.	6	0	0	......	......
.858	.711	.860	.810	W.SW.	SW ...	W.SW.	4	12	4	6.3	S. 53 W.	6	5	4	......	......
.904	.826	.898	.876	W.SW.	SW ...	W.SW.	12	12	4	9.3	S. 58 W.	8	6	10	......	.04
.900	.950	.942	.931	SW ...	N.NW.	W.NW.	4	25	12	11.3	N. 44 W.	10	10	10	......	.24
.878	.588	.888	.785	NE....	N. NE.	NE....	4	4	2	3.0	N. 36 E.	7	8	10	......	.82
.822	.720	.846	.796	E. NE.	E. SE.	SE....	4	2	2	2.3	N. 83 E.	10	10	3	......	......
.891	.695	.804	.797	W.SW.	W.SW.	W.SW.	2	2	2	2.0	S. 65 W.	10	10	10	......	......
.945	.764	.895	.868	NW ..	W.SW.	W.NW	2	12	12	8.3	S. 72 W.	10	2	10	......	......
.884	.599	.843	.775	W.NW	W.NW	W.....	4	4	2	3.3	N. 72 W.	10	9	0	......	.08
.890	.738	.754	.794	N. NE.	NW ...	W.SW.	2	12	2	4.3	N. 45 W.	10	3	3	......	......
.896	.779	.896	.857	SW ...	W.SW.	W.SW.	4	12	2	6.0	S. 61 W.	8	7	1	......	......
.891	.741	.852	.828	NE....	W.SW.	SW ...	2	4	2	1.3	S. 66 W.	3	8	9	......	......
.899	.701	.854	.818	SW ...	SW ...	W.SW.	4	4	2	3.3	S. 50 W.	2	1	0	......	......
.848	.636	.850	.778	N. NW.	W.....	SW ...	2	2	2	1.7	N. 80 W.	6	4	10	......	......
.848	.341	.653	.614	N. NE.	NW ..	NW ..	2	12	2	5.0	N. 38 W.	10	1	10	......	......
.891	.357	.631	.626	NE....	N.NW.	SW ...	2	12	2	4.0	N. 22 W.	6	2	0	......	.04
.769	.367	.601	.579	E. NE.	SW ...	SE....	2	4	2	1.3	N. 10 E.	6	5	10	......	......
.850	.692	.813	.785	....	....	....	....	....	....	5.5	S. 76 W.	7.2	5.5	5.1	......	1.88
.888	.852	.854	.865	SW ...	S. SW.	W.SW.	4	35	12	16.0	S. 35 W.	10	10	10	......	......
.685	.740	.718	.714	NW ..	W.NW	W.SW.	4	35	12	16.0	N. 76 W.	9	10	10	......	.16
.703	.629	.890	.741	NW ..	W.SW.	N. NW.	4	12	4	5.3	N. 83 W.	1	10	10	......	.04
.939	.882	.882	.901	N	NW ..	NW ..	4	4	2	3.3	N. 29 W.	10	10	1	......	2.14
.822	.511	.776	.703	NW ..	W.NW	NE....	12	15	2	12.0	N. 57 W.	1	10	10	......	.78
.776	.464	.568	.603	W.NW	NW ...	NW ...	4	12	4	6.7	N. 50 W.	1	1	0	......	......
.765	.668	.786	.740	NW ...	W.SW.	N NE.	2	25	12	6.7	N. 82 W.	9	2	3	......	......
.937	.545	.772	.751	E.SE..	NE....	SE....	2	2	4	2.3	S. 73 E.	9	10	10	......	......
.935	.708	.713	.785	NE....	W.NW	NW ...	25	4	2	8.0	N. 31 E.	10	10	8	......	.48
.875	.582	.776	.744	N. NW.	W.....	NW ...	2	4	2	2.3	N. 63 W.	2	8	0	......	......
.874	.593	.727	.731	E. NE.	W.SW.	NE....	2	4	2	2.3	N. 4 W.	4	6	0	......	......
.776	.644	.838	.753	E.....	SW ...	S. by E.	2	2	4	2.0	S. 13 E.	10	10	10	......	......
.846	.860	.949	.885	SW ...	W.SW.	SW ...	12	12	2	8.7	S. 56 W.	10	10	10	......	.42
.944	.764	.896	.868	SW,W.	SW ...	W.SW.	2	4	12	6.0	S. 62 W.	10	10	10	......	.04
.783	.704	.812	.766	N. NE.	NE....	NW ...	4	4	2	2.7	N. 21 E.	8	10	0	......	......
.733	.575	.561	.656	NE, N	N. NE.	NE, N.	4	4	2	3.3	N. 29 E.	1	0	0	......	......
.681	.525	.636	.614	SW ...	W.SW.	W.SW.	2	12	12	8.7	S. 66 W.	1	0	8	......	......
.718	.716	.743	.726	W.SW.	W.SW.	W.SW.	12	12	4	9.3	S. 67 W.	2	9	10	......	......
.886	.880	.880	.882	NE....	NE....	NE....	2	12	2	5.3	N. 45 E.	10	10	9	......	......
.809	.557	.698	.688	NE....	W.SW.	NE....	2	4	2	0.7	N. 28 W.	2	8	2	......	.06
.816	.588	.670	.658	SW ...	W.SW.	NW ...	2	25	2	9.0	S. 69 W.	10	7	1	......	.12
.809	.479	.869	.719	NW ...	W.....	NW ...	12	4	2	5.7	N. 55 W.	7	9	10	......	.48
.861	.575	.798	.745	E. SE.	W.SW.	NW ...	2	12	2	3.7	S. 68 W.	4	9	10	......	......
.790	.659	.733	.727	W.NW	W.....	NW ...	4	12	2	6.3	N. 81 W.	6	9	1	......	.02
.738	.527	.681	.649	NW ...	W.SW.	NW ...	2	25	2	8.7	S. 75 W.	1	9	9	......	.06
.872	.685	.727	.761	SW ...	W.SW.	W.SW.	4	45	35	28.0	S. 66 W.	10	10	2	......	......
.825	.539	.886	.750	W.SW.	W.SW.	S......	25	12	2	12.7	S. 65 W.	10	4	7	......	......
.713	.758	.890	.787	SE....	S. SW.	SE....	2	4	4	2.3	S. 29 E.	1	10	1	......	......
.940	.570	.831	.780	N. NW.	NW ...	NE....	4	4	2	2.7	N. 21 W.	10	9	0	......	......
.937	.700	.783	.867	E. by N.	SW ...	W.SW.	2	4	4	2.0	S. 49 W.	10	10	10	......	......
.886	.658	.843	.796	NE....	NE....	NE....	2	4	2	2.7	N. 45 E.	10	6	10	......	......
.824	.649	.780	.751	....	....	....	....	....	....	4.5	S. 85 W.	6.4	4.7	5.9	......	4.80

Reductions of the monthly meteorological register of the survey of

Date.	Barometer reduced to temperature of 32° Fahr., expressed in United States inches and decimals.				TEMPERATURE—FAHRENHEIT.									VAPOR.			
					Wet bulb, or point of evaporation.			Dry bulb, or temperature of the open air.				Maximum.	Minimum.	Elasticity, in U. S. inches and decimals.			
	7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	Mean.			7 a. m.	2 p. m.	9 p. m.	Mean.
1866.					°	°	°	°	°	°	°	°	°				
Sept. 1	29.233	29.240	29.082	29.185	66	69	70	69	75	74	72.8	82	67	.599	.728	.679	.669
2	29.122	29.132	29.251	29.168	68	71	64	70	74	66	70.0	78	67	.658	.718	.569	.648
3	29.356	29.358	29.351	29.355	63	68	03	64	71	66	67.0	73	61	.562	.644	.536	.581
4	29.374	29.214	29.178	29.255	59	75	64	61	80	68	69.7	81	61	.473	.800	.543	.605
5	29.181	29.245	29.314	29.247	68	66	55	70	72	61	67.7	72	61	.658	.559	.354	.557
6	29.437	29.428	29.414	29.426	57	61	58	60	71	61	64.0	71	55	.426	.403	.443	.424
7	29.312	29.111	29.038	29.154	55	58	59	58	59	60	59.0	63	54	.393	.469	.487	.450
8	29.143	29.294	29.367	28.268	57	60	54	58	65	56	59.7	65	57	.452	.451	.391	.431
9	29.497	29.548	29.522	29.522	54	62	56	56	67	58	60.3	68	52	.391	.489	.422	.434
10	29.567	29.453	29.377	29.466	53	63	58	56	69	60	61.7	70	51	.363	.495	.456	.438
11	29.377	28.975	28.912	29.088	59	67	67	60	69	70	66.3	70	58	.487	.635	.622	.581
12	28.973	28.983	28.985	28.980	60	63	60	62	66	65	64.3	70	57	.491	.536	.451	.493
13	29.240	29.286	29.307	29.278	52	55	55	59	64	60	61.0	66	57	.296	.314	.367	.326
14	29.325	29.163	29.363	29.284	32	63	47	34	66	50	50.0	67	50	.168	.536	.283	.329
15	29.562	29.650	29.659	29.624	40	48	43	43	55	44	47.3	56	41	.208	.243	.264	.238
16	29.563	29.424	29.327	29.438	47	62	54	49	65	56	56.7	66	45	.297	.516	.391	.401
17	29.279	29.137	28.330	29.249	62	59	52	63	60	55	59.3	66	55	.542	.487	.349	.459
18	29.301	29.288	29.243	29.277	50	51	49	51	52	50	51.0	58	51	.348	.361	.335	.348
19	29.236	29.295	29.371	29.301	47	50	49	48	53	51	50.7	54	50	.310	.321	.321	.317
20	29.343	29.206	29.041	29.197	47	52	54	49	53	45	49.0	56	49	.297	.375	.404	.359
21	29.164	29.280	29.358	29.267	49	51	46	50	55	48	51.0	68	49	.335	.321	.284	.313
22	29.524	29.575	29.559	29.553	41	48	42	42	53	44	46.3	57	39	.244	.269	.241	.251
23	29.630	29.577	29.521	29.576	38	51	45	40	60	47	49.0	61	38	.203	.255	.273	.244
24	29.534	29.453	29.406	29.464	44	63	59	46	69	64	59.7	70	44	.262	.495	.433	.397
25	29.424	29.274	29.298	29.332	61	60	51	65	61	52	59.3	68	53	.483	.505	.361	.450
26	29.491	29.495	29.492	29.493	46	49	43	47	53	43	47.7	54	45	.297	.295	.278	.290
27	29.518	29.545	28.567	29.543	50	51	55	52	57	56	55.0	64	43	.334	.295	.420	.350
28	29.668	29.623	29.559	29.617	50	52	61	52	69	63	61.3	71	45	.334	.163	.510	.336
29	29.621	29.650	29.514	29.595	48	67	58	51	74	61	62.0	73	47	.296	.568	.443	.436
30	29.546	29.598	29.492	29.545	46	61	56	49	67	58	58.0	69	46	.271	.457	.422	.383
Means....	29.385	29.350	29.340	29.358	....	....	....	54.4	64.1	57.1	58.5	....	....	.382	.457	.411	.417
Oct. 1	29.553	29.505	29.454	29.497	49	65	59	50	72	61	61.0	74	51	.335	.524	.473	.444
2	29.377	29.271	29.206	29.285	56	63	63	60	70	64	64.7	71	57	.396	.482	.562	.480
3	29.404	29.411	29.437	29.417	43	45	39	46	51	41	46.0	64	43	.238	.220	.212	.223
4	29.562	29.643	29.702	29.636	41	43	35	43	50	39	44.0	51	41	.231	.186	.152	.190
5	29.911	29.820	29.787	29.839	31	46	37	32	55	41	42.7	55	31	.162	.192	.168	.174
6	29.824	29.724	29.618	29.722	38	51	45	42	61	48	53.7	61	36	.177	.242	.260	.226
7	29.610	29.546	29.494	29.550	57	62	59	59	64	61	61.3	66	47	.439	.529	.473	.480
8	29.470	29.441	29.375	29.429	58	62	56	59	66	57	60.7	67	59	.469	.502	.436	.469
9	29.407	28.318	29.317	29.347	54	67	58	56	75	60	63.7	77	53	.391	.554	.456	.467
10	29.362	29.358	29.382	29.367	56	60	54	58	67	58	61.0	67	59	.422	.425	.365	.404
11	29.433	29.394	29.350	29.392	52	59	53	54	65	55	58.0	65	54	.362	.420	.376	.386
12	29.391	29.332	29.343	29.355	46	51	48	47	62	50	53.0	63	48	.297	.229	.309	.278
13	29.456	29.457	29.464	29.459	48	55	44	49	60	46	51.7	60	48	.322	.367	.262	.317
14	29.622	29.645	29.671	29.646	42	49	43	43	57	47	49.0	57	43	.254	.242	.225	.240
15	29.792	29.774	29.758	29.775	41	53	47	43	61	52	52.0	62	42	.231	.297	.257	.262
16	29.760	29.689	29.682	29.710	39	56	56	40	63	58	53.7	63	42	.225	.356	.422	.334
17	29.523	29.429	29.412	29.455	48	58	56	50	63	58	57.0	63	51	.309	.416	.422	.382
18	29.495	29.448	29.428	29.457	52	65	49	53	71	52	58.7	71	51	.375	.537	.308	.407
19	29.422	29.424	29.432	29.426	53	60	57	58	65	62	61.7	71	50	.336	.451	.399	.395
20	29.530	29.428	29.415	29.458	54	61	54	55	67	57	59.7	69	56	.404	.457	.378	.413
21	29.379	29.291	29.150	29.273	56	59	58	63	70	67	66.7	72	58	.356	.247	.363	.322
22	28.958	29.141	29.169	29.089	59	51	48	64	59	56	59.7	79	57	.433	.269	.230	.311
23	29.169	29.137	29.175	29.160	44	43	38	48	49	42	46.3	56	42	.236	.199	.177	.204
24	29.226	29.297	29.405	29.309	32	38	35	34	41	38	37.7	44	34	.155	.190	.165	.170
25	29.545	29.540	29.535	29.540	33	36	31	34	40	34	36.0	43	36	.175	.160	.139	.158
26	29.423	29.352	29.214	29.330	32	41	44	35	43	46	41.3	46	37	.155	.231	.241	.209
27	29.430	29.494	29.560	29.495	38	42	38	40	46	40	42.0	48	42	.203	.215	.203	.207
28	29.632	29.410	29.371	29.471	38	48	45	39	55	52	48.7	56	39	.216	.243	.207	.222
29	29.273	29.164	29.036	29.158	47	53	52	50	54	53	52.3	55	51	.283	.389	.375	.349
30	29.087	29.064	29.100	29.084	39	45	38	41	50	40	43.7	52	42	.212	.234	.203	.216
31	29.308	29.410	29.463	29.394	32	36	32	33	40	35	36.0	42	34	.168	.160	.142	.157
Means....	29.463	29.431	29.416	29.437	....	....	....	47.7	58.8	50.6	52.4	....	....	.290	.328	.302	.307

the northern and northwestern lakes at Buffalo, New York.

VAPOR.				WIND.								Amount of cloudiness. (0=clear sky) (10=sky entirely overcast.)			Amount of evaporation in U. S. inches and decimals.	Amount of rain or melted snow, in U. S. inches and decimals.
Humidity. Saturation = 1,000.				Direction. From whence.			Velocity, in miles, per hour.			Resultant velocity, in miles per hour.	Resultant direction.					
7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.			7 a. m.	2 p. m.	9 p. m.		
.846	.724	.810	.793	NE	N.NW	SE	2	4	4	1.3	N. 47 E.	10	10	10	......	......
.898	.856	.891	.882	S by W	W.SW.	N.NW.	4	25	2	8.7	S. 69 W.	10	10	0	......	.20
.943	.850	.838	.877	NW	S.SW.	NE	2	2	2	0.7	N. 23 W.	10	10	10	......	......
.882	.782	.793	.786	E.NE	E.SE	NE	2	2	4	2.3	N. 66 E.	1	0	10	......	......
.898	.712	.659	.756	SW	SW	NW	4	25	2	9.7	S. 49 W.	10	3	0	......	......
.822	.532	.825	.726	SW	SW	SW	2	12	2	5.3	S. 45 W.	1	1	0	......	.30
.816	.939	.940	.898	E.NE	NE	SW.W.	2	4	4	0.7	N. 19 W.	10	10	10	......	......
.937	.731	.872	.847	W	W	NE	2	4	2	1.7	N. 74 W.	10	9	0	......	1.30
.872	.740	.876	.829	N.NW.	W.SW	N	2	4	2	1.7	N. 63 W.	1	9	0	......	.20
.809	.700	.880	.796	N	W.SW.	NE	2	4	2	1.0	N. 49 W.	1	4	3	......	......
.940	.896	.848	.895	NE	SW	SW	4	4	12	4.0	S. 45 W.	10	10	10	......	.08
.884	.838	.731	.818	SW	SW	SW	12	45	35	30.1	S. 45 W.	10	10	0	......	.76
.592	.527	.708	.609	W.SW.	W.SW.	NW	12	45	12	21.0	S. 78 W.	2	10	10	......	.02
.893	.838	.786	.839	SE	W.SW.	NW	2	12	12	6.3	N. 82 W.	10	10	10	......	......
.750	.561	.918	.743	NW	SW	NW	4	2	2	2.0	N. 65 W.	3	9	2	......	.10
.853	.836	.872	.854	W.NW	S	S	2	4	4	2.7	S. 13 W.	10	10	10	......	......
.942	.940	.805	.896	SW	NE	NE	12	2	2	2.7	S. 45 W.	10	10	10	......	.18
.929	.930	.927	.929	E	NE	NE	2	2	4	2.7	N. 53 E.	10	10	10	......	.32
.925	.798	.859	.861	NE	NE	NE	4	4	2	3.3	N. 45 E.	10	10	10	......	.52
.953	.932	.934	.906	NE	NE	NE	4	2	2	2.6	N. 45 E.	10	10	10	......	.06
.927	.743	.850	.840	W.SW.	N.NE	N	4	4	2	1.7	N. 26 W.	10	10	10	......	.76
.914	.667	.836	.806	NW	N	NE	2	4	2	2.3	North	1	8	9	......	......
.820	.493	.847	.720	E by N.	E	E	2	4	14	3.3	East	10	8	0	......	......
.843	.700	.727	.757	E by S.	SW	SW	2	2	12	4.3	S. 37 W.	0	10	10	......	......
.783	.941	.930	.885	SE	NE	N	4	2	25	8.0	N. 10 E.	10	10	10	......	......
.923	.733	1.000	.885	NE	N	......	4	4	....	2.3	N. 24 E.	10	10	0	......	2.14
.861	.634	.935	.810	SW	SW	SW	2	2	2	2.0	S. 45 W.	0	3	0	......	......
.861	.231	.886	.659	S	S	N	2	4	2	1.3	South	0	0	0	......	......
.790	.677	.825	.764	NE	NE	N	2	2	2	1.7	N. 34 E.	1	7	0	......	......
.781	.690	.876	.782	E by S.	W.SW.	NE	2	2	2	0.3	N. 78 E.	7	10	1	......	......
.859	.739	.849	.815	......	......	......	....	....	....	2.3	S. 69 W.	6.6	8.0	5.5	......	6.94
.927	.668	.882	.826	E.SE	N.NW.	NE	2	4	2	1.7	N. 20 E.	10	10	0	......	......
.765	.658	.943	.789	SW	W	W.SW.	4	12	2	5.9	S. 78 W.	0	2	10	......	......
.767	.590	.824	.727	N	N	N	12	12	2	8.7	North	10	4	0	......	......
.833	.515	.636	.661	NE	NE	NE	2	12	2	5.3	N. 45 E.	10	4	0	......	......
.896	.445	.653	.665	E by S.	NE	NE	2	2	2	1.7	N. 61 E.	10	2	0	......	......
.661	.452	.777	.630	E.SE	SW	NE	2	2	2	0.7	S. 65 E.	0	0	0	......	......
.878	.888	.882	.883	SW	SW	SW	4	12	4	6.7	S. 45 W.	10	10	0	......	......
.939	.786	.936	.887	W.SW.	W.SW.	E	2	12	2	4.0	S. 63 W.	10	1	0	......	......
.872	.639	.880	.797	E.SE	W.SW.	SE	2	2	12	4.3	S. 40 E.	3	9	10	......	......
.876	.642	.765	.761	E	SE	SE	2	12	4	6.0	S. 49 E.	10	9	10	......	.30
.867	.680	.869	.805	NE	NE	NE	2	4	4	3.3	N. 45 E.	10	10	0	......	.08
.923	.412	.856	.730	NE	NE	NE	2	12	2	5.3	N. 45 E.	1	7	0	......	......
.926	.708	.843	.826	NE	N	NE	2	4	2	2.3	N. 24 E.	10	1	0	......	......
.916	.521	.698	.712	NE	NE	NE	2	4	2	2.6	N. 45 E.	1	0	0	......	......
.833	.553	.660	.682	NE	NE	NE	2	4	2	2.6	N. 45 E.	0	0	0	......	......
.910	.619	.876	.802	E.SE.	W.SW.	W.SW.	2	4	4	2.3	S. 56 W.	1	2	0	......	......
.856	.723	.876	.818	W.SW.	W.SW.	W.SW.	2	12	4	6.0	S. 68 W.	1	9	0	......	......
.932	.708	.794	.811	SW.W.	W.SW.	NE	2	2	2	0.7	S. 79 W.	0	0	0	......	......
.698	.731	.718	.716	SW	W.SW.	SE	12	4	2	5.3	S. 42 W.	10	10	10	......	......
.934	.690	.812	.812	E. by N	SW	E	2	4	2	1.0	S. 24 E.	10	9	10	......	......
.619	.258	.550	.476	S.SE.	SE	E	4	12	4	6.3	S. 48 E.	4	9	10	......	......
.727	.537	.512	.592	SW	SW	SW	25	60	45	43.3	S. 45 W.	9	6	4	......	......
.704	.572	.661	.646	SW	SW	SW	35	45	4	28.0	S. 45 W.	10	9	10	......	.08
.792	.738	.719	.750	W.NW	NW	N by W	4	4	12	6.3	N. 28 W.	1	10	10	......	.34
.895	.645	.712	.751	NE	NE	NE	2	2	2	2.0	N. 45 E.	10	10	0	......	......
.792	.833	.836	.820	SE	SW	SW	4	12	12	8.0	S. 37 W.	10	10	10	......	......
.820	.691	.820	.777	W by S	W	NE	4	4	2	2.0	N. 84 W.	10	10	10	......	.18
.907	.561	.535	.668	E.NE	E.SE	SE	2	12	2	5.0	S. 69 E.	10	10	10	......	.06
.786	.933	.932	.884	SE	S	NW	4	2	4	0.7	South	10	10	10	......	.08
.824	.646	.820	.763	W	NW	NW	2	12	4	6.0	N. 50 W.	10	6	10	......	.98
.893	.645	.698	.745	W.NW	W.NW	N	4	12	2	5.7	N. 61 W.	1	10	1	......	.06
.834	.635	.773	.749	......	......	......	....	....	....	2.5	S. 51 W	6.5	6.4	4.4	......	2.16

Reductions of the monthly meteorological register of the survey of

Date.	Barometer reduced to temperature of 32° Fahr., expressed in United States inches and decimals.				TEMPERATURE—FAHRENHEIT.									VAPOR.			
					Wet bulb, or point of evaporation.			Dry bulb, or temperature of the open air.				Maximum.	Minimum.	Elasticity, in U. S. inches and decimals.			
	7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	Mean.			7 a. m.	2 p. m.	9 p. m.	Mean.
1866.					°	°	°	°	°	°	°	°	°				
Nov. 1	29.445	29.254	29.147	29.282	35	40	41	38	46	49	44.3	50	35	.165	.169	.153	.16[illegible]
2	29.364	29.454	29.494	29.437	41	39	37	42	42	42	42.0	52	43	.244	.199	.155	.199
3	29.655	29.640	29.675	29.657	33	36	32	34	40	34	36.0	43	36	.175	.160	.155	.163
4	29.825	29.835	29.881	29.850	33	35	29	34	38	32	34.7	40	32	.175	.165	.126	.155
5	30.019	30.000	29.971	29.997	28	33	31	29	36	32	32.3	36	32	.142	.149	.162	.151
6	29.955	29.856	29.763	29.858	22	41	34	23	45	35	34.3	45	25	.107	.205	.183	.165
7	29.702	29.583	29.519	29.601	38	49	42	43	54	44	47.0	54	37	.164	.282	.241	.22[illegible]
8	29.471	29.420	29.388	29.426	40	50	49	47	55	52	51.3	56	45	.156	.295	.308	.253
9	29.486	29.468	29.401	29.452	44	49	48	45	52	51	49.3	54	48	.275	.308	.296	.293
10	29.494	29.415	29.279	29.396	40	46	41	42	53	44	46.3	53	44	.221	.219	.218	.219
11	29.029	29.129	29.226	29.128	49	44	41	52	48	45	48.3	53	46	.308	.236	.205	.250
12	29.448	29.516	29.632	29.532	36	40	35	37	45	39	40.3	46	39	.199	.182	.152	.178
13	29.758	29.688	29.602	29.683	31	44	37	33	48	39	40.0	48	31	.151	.236	.194	.194
14	29.509	29.395	29.331	29.412	36	46	41	44	53	47	48.0	54	39	.108	.219	.179	.169
15	29.192	28.897	28.680	28.923	42	48	47	43	49	48	46.7	49	45	.254	.322	.310	.295
16	28.638	28.641	28.796	28.692	36	45	37	37	47	38	40.7	49	38	.199	.273	.207	.226
17	29.048	29.057	29.203	29.103	36	38	35	37	41	39	39.0	42	39	.199	.190	.152	.180
18	29.222	29.226	29.260	29.236	40	42	38	43	45	40	42.7	45	41	.208	.228	.203	.213
19	29.087	28.939	28.872	28.966	43	47	45	45	52	47	48.0	52	42	.251	.257	.273	.260
20	28.885	28.950	29.095	28.977	40	39	37	42	44	38	41.3	49	41	.221	.173	.207	.200
21	29.208	29.275	29.253	29.245	31	34	28	33	38	31	37.3	39	35	.151	.144	.119	.138
22	29.141	29.036	29.113	29.097	27	29	30	28	30	31	29.7	37	26	.136	.149	.155	.147
23	29.334	29.343	29.377	29.351	26	30	24	27	31	26	28.0	33	25	.129	.155	.106	.130
24	29.409	29.375	29.373	29.389	23	32	29	25	34	31	30.0	35	23	.100	.155	.137	.131
25	29.655	29.579	29.544	29.593	22	27	25	23	29	27	26.3	33	23	.107	.124	.112	.114
26	29.508	29.447	29.432	29.462	30	36	36	33	41	39	37.7	45	27	.132	.147	.173	.151
27	29.480	29.373	29.302	29.385	34	48	39	36	54	43	44.3	54	34	.107	.256	.186	.204
28	29.213	29.063	29.079	29.118	52	55	51	54	58	52	54.7	58	48	.362	.393	.361	.372
29	29.049	29.035	29.040	29.041	47	45	43	48	46	44	46.0	56	43	.310	.286	.264	.267
30	29.080	29.098	29.226	29.135	33	34	32	36	37	34	35.7	46	33	.149	.157	.155	.154
Means....	29.377	29.333	29.332	29.347	....	....	....	37.8	44.4	39.8	40.7	....	....	.188	.214	.195	.199
Dec. 1	29.501	29.506	29.489	29.499	27	29	26	28	30	29	29.0	35	28	.136	.149	.106	.130
2	29.539	29.540	29.545	29.541	26	32	31	29	36	34	33.0	37	27	.106	.129	.139	.125
3	29.946	29.358	29.205	29.503	28	39	35	30	48	42	40.0	49	28	.130	.121	.113	.121
4	29.027	29.960	29.160	29.049	40	43	42	41	44	44	43.0	45	40	.235	.264	.241	.247
5	29.515	29.589	29.608	29.571	36	42	36	38	44	37	39.7	46	37	.186	.241	.199	.209
6	29.572	29.412	29.352	29.445	37	40	41	39	43	43	41.7	44	33	.194	.208	.231	.211
7	29.432	29.374	29.257	29.354	42	44	39	43	46	41	43.3	48	42	.254	.262	.212	.243
8	29.204	28.783	28.885	28.957	50	48	39	54	51	42	49.0	57	36	.308	.296	.199	.268
9	29.154	29.141	29.034	29.110	24	27	22	27	32	23	27.3	43	23	.095	.090	.107	.09[illegible]
10	29.115	29.230	29.255	29.200	13	16	13	15	17	15	15.7	31	11	.056	.078	.056	.063
11	29.331	29.273	29.275	29.293	16	18	17	17	20	19	18.7	22	11	.078	.076	.071	.075
12	29.411	29.431	29.443	29.428	15	16	14	17	17	16	16.7	29	10	.063	.078	.059	.067
13	29.433	29.485	29.441	29.453	15	18	16	16	19	17	17.3	29	13	.074	.087	.078	.080
14	29.699	29.742	29.792	29.744	9	8	8	10	9	9	09.3	28	8	.054	.051	.051	.052
15	29.924	29.751	29.644	29.773	11	12	11	12	13	12	12.3	27	13	.061	.063	.061	.062
16	29.225	29.007	29.005	29.079	18	21	18	19	22	19	20.0	28	3	.087	.101	.087	.092
17	29.087	29.172	29.351	29.203	21	22	26	22	24	28	24.7	33	18	.101	.095	.117	.104
18	29.587	29.526	29.495	29.536	24	29	21	26	30	23	26.3	35	23	.106	.149	.090	.115
19	29.405	29.385	29.421	29.404	32	31	26	34	34	28	32.0	35	31	.155	.139	.117	.137
20	29.888	29.955	29.982	29.942	2	7	- 3	3	8	- 2	03.0	34	- 2	.036	.048	.026	.037
21	29.891	29.698	29.573	29.721	- 6	15	13	- 5	18	16	09.7	21	- 9	.021	.052	.044	.039
22	29.481	29.360	29.182	29.341	25	31	34	28	36	37	33.7	38	9	.100	.116	.157	.124
23	28.943	28.710	28.493	28.715	39	42	42	41	44	43	42.7	46	31	.212	.241	.254	.236
24	28.853	28.888	28.941	28.894	34	32	30	35	33	32	33.3	45	30	.183	.168	.144	.165
25	29.097	29.139	29.244	29.160	25	23	21	26	25	23	24.7	33	22	.123	.100	.090	.104
26	29.343	29.163	29.021	29.176	19	28	27	20	31	28	26.3	33	18	.092	.119	.136	.116
27	28.995	28.987	29.107	29.030	18	24	17	19	26	18	21.0	32	18	.087	.106	.083	.092
28	29.136	29.162	29.207	29.168	10	18	17	11	20	18	16.3	32	11	.057	.076	.083	.072
29	29.436	29.417	29.433	29.429	14	19	14	15	22	16	17.7	31	14	.071	.069	.059	.066
30	29.551	29.588	29.574	29.571	12	16	11	13	18	12	14.3	30	12	.063	.067	.061	.064
31	29.502	29.439	29.460	29.467	8	26	19	9	29	21	19.7	30	7	.051	.106	.080	.079
Means....	29.375	29.341	29.318	29.345	....	....	....	23.6	28.7	25.3	25.9	....	....	.115	.127	.115	.119

the northern and northwestern lakes at Buffalo, New York.

VAPOR.				WIND.								Amount of cloudiness. (0 = clear sky.) (10 = sky entirely overcast.			Amount of evaporation, in U. S. inches and decimals.	Amount of rain or melted snow, in U. S. inches and decimals.
Humidity. Saturation = 1,000.				Direction. From whence.			Velocity, in miles, per hour.			Resultant velocity, in miles, per hour.	Resultant direction.					
7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.			7 a. m.	2 p. m.	9 p. m.		
											°					
.719	.543	.439	.567	S	S	SW	12	35	45	28.3	S. 22 W.	10	10	10	......	......
.914	.744	.577	.745	NW	NW	NW	2	12	2	5.3	N. 45 W.	10	10	10	......	......
.895	.645	.792	.777	NW	NW	NW	2	2	2	2.0	N. 45 W.	10	6	0	......	......
.895	.719	.694	.769	NW	NW	NW	2	4	2	2.7	N. 45 W.	10	7	10	......	......
.887	.705	.896	.829	NE	NE	NE	2	2	2	2.0	N. 45 E	10	7	0	......	......
.864	.684	.898	.815	SE	S. SW.	NE	2	4	2	1.3	S. 30 E.	0	0	0	......	......
.587	.674	.836	.699	SW.	S. SW.	W.SW.	2	4	2	2.3	S. 36 W.	9	0	0	......	......
.483	.681	.794	.653	SW	SW	SW	2	4	4	3.3	S. 45 W.	0	8	10	......	......
.920	.794	.790	.835	W.SW.	W.SW.	W.SW.	2	12	4	6.0	S. 79 W.	4	10	0	......	......
.829	.544	.756	.730	W.SW.	NE	E	2	2	4	1.3	N. 76 E.	0	10	10	......	......
.794	.704	.684	.727	SW	SW,W.	NW	12	25	12	13.3	S. 70 W.	10	9	3	......	.20
.903	.607	.636	.715	NW	NW	NW	2	4	2	2.7	N. 45 W.	1	10	1	......	.04
.800	.704	.816	.773	NE	E. NE.	E. SE.	2	2	4	2.7	N. 83 E.	1	0	10	......	......
.372	.544	.554	.490	SE	SE	SE	4	4	4	4.3	S. 45 E	10	10	10	......	......
.916	.926	.925	.922	NE	E. NE.	NW	2	2	2	1.3	N. 30 E.	10	10	10	......	.24
.903	.847	.905	.885	W	W.NW	W.NW	4	12	12	9.3	N. 80 W.	10	10	10	......	.98
.903	.738	.636	.759	W	W	W	2	4	2	2.7	West	8	10	10	......	.40
.750	.762	.820	.777	SW	SW	SW	12	12	4	9.3	S. 45 W.	10	10	10	......	......
.840	.660	.817	.782	SE	SE	SE	2	2	4	2.7	S. 45 E.	10	10	10	......	......
.829	.597	.905	.777	W	W	W	12	4	12	9.3	West	10	10	10	......	.20
.800	.628	.685	.704	W,by N	W	NW	2	4	2	2.7	N. 77 W.	6	9	10	......	.04
.883	.890	.893	.889	NE	NE	N. NW.	4	4	4	3.7	N. 26 E.	10	10	10	......	.06
.880	.893	.754	.842	NW	NW	NW	2	4	4	3.3	N. 45 W	10	10	10	......	.10
.746	.792	.788	.775	NW	SW	W	4	4	12	5.7	West	10	10	10	......	......
.864	.775	.761	.800	NE	NE	S	2	2	2	1.0	N. 75 E.	10	8	10	......	......
.703	.567	.726	.665	S. SW.	SW	SE	4	4	2	3.0	S. 14 W.	10	10	0	......	......
.802	.613	.669	.685	S	S	S	2	2	4	2.7	South	4	10	10	......	......
.867	.816	.930	.871	S. by W	SW	W.SW,	4	12	4	6.3	S. 45 W.	10	10	10	......	......
.925	.921	.918	.921	SW	SW	NE	2	2	2	0.7	S. 45 W.	10	10	10	......	.80
.705	.712	.792	.736	SW	W	W.SW.	4	12	12	9.0	S. 81 W.	10	10	10	......	.16
.806	.714	.770	.763	....	....	....	....	....	....	3.0	S. 63 W.	7.8	8.5	7.5	......	3.22
.883	.890	.665	.813	NW	NW	NW	12	12	4	9.3	N. 45 W.	10	9	10	......	......
.665	.610	.712	.662	SE	SW, W	SW	2	12	4	5.3	S. 43 W.	10	4	0	......	......
.782	.359	.420	.520	SE	SW	SE	2	2	12	4.7	S. 37 E.	10	10	10	......	......
.912	.918	.836	.889	NE	SW	W.SW.	2	4	25	9.0	S. 66 W.	10	10	10	......	.16
.811	.836	.903	.850	W.SW.	W.SW.	E	2	2	2	0.7	S. 45 W.	1	10	0	......	.46
.816	.750	.833	.800	NE	W	W.SW.	2	2	2	1.0	N. 79 W.	10	10	10	......	......
.916	.843	.824	.861	SW	SW	SE	2	2	2	1.7	S. 16 W.	10	10	0	......	......
.738	.790	.744	.757	W	SW	SW	12	25	35	24.0	S. 45 W.	10	9	10	......	......
.644	.496	.864	.668	W.NW	W.SW.	NW	4	35	12	15.3	S. 86 W.	10	10	10	......	.40
.648	.834	.648	.710	W	W.by N	NW	12	12	2	8.7	N. 82 W.	10	1	0	......	.34
.834	.702	.692	.743	NW	SW	SW	12	25	2	9.7	S. 69 W.	10	10	10	......	.22
.671	.834	.659	.721	W	W	W	2	2	2	2.0	West	10	10	10	......	.62
.829	.845	.834	.836	NW	NW	NW	4	2	2	2.7	N. 45 W.	10	10	10	......	......
.791	.784	.784	.786	NW	NW	NW	2	2	2	2.0	N. 45 W.	10	10	2	......	......
.804	.810	.804	.806	NE	NE	NE	2	2	4	2.7	N. 45 E	10	10	10	......	......
.845	.860	.845	.850	NE	NE	NE	4	4	4	4.0	N. 45 E	10	10	10	......	.36
.860	.738	.768	.789	N	W.NW	NW	4	4	4	3.7	N. 38 W.	10	10	10	......	.66
.754	.890	.730	.791	W.NW	SW	SW	2	12	4	5.7	S. 51 W.	10	10	10	......	......
.792	.712	.768	.757	W.SW.	W.SW.	NW	12	4	12	8.0	N. 84 W.	10	10	10	......	......
.730	.777	.671	.726	NE	NE	NE	2	2	2	2.0	N. 45 E.	10	3	1	......	.18
.627	.525	.492	.548	NE	NE	NE	2	2	2	2.0	N. 45 E.	10	10	1	......	......
.655	.550	.712	.639	SE	SE	SE	4	2	2	2.7	S. 45 E	10	10	10	......	......
.824	.836	.916	.859	SW	SW	SE	4	4	2	2.7	S. 7 E.	10	10	10	......	.04
.898	.893	.794	.862	SW	SW	SW	4	12	12	9.3	S. 45 W	10	10	10	......	.16
.876	.746	.730	.784	NW	NW	NW	4	4	4	4.0	N. 45 W.	10	10	10	......	.40
.850	.685	.883	.806	SW	SE	NE	4	12	4	4.0	S. 45 E.	2	10	10	......	.02
.845	.754	.840	.813	NW	NW	NW	4	12	12	9.3	N. 45 W.	10	9	0	......	.20
.797	.702	.840	.780	W.NW	W.NW	W.NW	12	12	12	12.0	N. 68 W.	10	10	10	......	......
.823	.584	.659	.689	W.NW	W	NW	4	4	4	3.7	N. 67 W.	10	10	10	......	......
.810	.682	.804	.765	NW	NW	NE	4	2	2	2.0	N. 26 W.	10	10	0	......	......
.784	.665	.712	.720	NE	S	NE	2	2	2	1.0	N. 75 E.	10	7	10	......	......
.791	.739	.754	.761	....	....	....	....	....	....	3.4	S. 84 W.	9.4	9.1	7.2	......	4.22

Reductions of the monthly meteorological register of the survey of

Date.	Barometer reduced to temperature of 32° Fahr., expressed in United States inches and decimals.				TEMPERATURE—FAHRENHEIT.									VAPOR.			
					Wet bulb, or point of evaporation.			Dry bulb, or temperature of the open air.				Maximum.	Minimum.	Elasticity, in U. S. inches and decimals.			
	7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	Mean.			7 a. m.	2 p. m.	9 p. m.	Mean.
1866.					°	°	°	°	°	°	°	°	°				
July 1	30.081	29.965	29.998	30.015	57	61	58	60	63	61	61.3	65	55	.426	.510	.443	.460
2	30.021	29.943	29.826	29.930	66	75	67	68	78	70	72.0	79	65	.612	.827	.622	.687
3	29.810	29.611	29.538	29.653	71	79	63	74	82	65	73.7	83	63	.718	.949	.549	.739
4	29.521	29.658	29.663	29.614	62	69	58	65	71	60	65.3	72	52	.516	.682	.456	.551
5	29.675	29.705	29.755	29.712	69	78	67	70	81	70	73.7	82	67	.695	.918	.622	.745
6	29.791	29.763	29.684	29.746	73	78	78	76	83	80	79.7	84	69	.771	.890	.931	.864
7	29.723	29.740	29.755	29.739	72	80	72	75	82	74	77.0	83	70	.744	.996	.757	.832
8	29.600	29.608	29.720	29.643	73	73	67	75	76	70	73.7	80	67	.784	.771	.622	.726
9	29.918	30.010	29.933	29.954	62	65	58	64	67	60	63.7	71	58	.529	.591	.456	.525
10	30.033	30.088	30.006	30.042	60	69	65	62	71	67	66.7	72	57	.491	.682	.591	.588
11	30.058	29.993	29.995	30.015	64	74	68	66	77	70	71.0	79	60	.569	.799	.658	.675
12	29.858	29.741	29.765	29.788	67	82	77	70	85	80	78.3	85	65	.622	.051	.887	.520
13	29.733	29.673	29.630	29.679	74	87	81	77	90	84	83.7	91	72	.799	.242	.016	.352
14	29.752	29.762	29.700	29.738	73	75	68	76	77	70	74.3	80	67	.854	.841	.658	.784
15	29.818	29.859	29.829	29.835	72	87	82	75	90	85	83.3	90	69	.744	.242	.051	.346
16	29.993	29.925	29.950	29.956	79	90	82	81	93	84	86.0	93	75	.963	.369	.016	.449
17	29.803	29.855	29.624	29.761	79	85	70	82	88	72	80.7	90	70	.949	.162	.706	.606
18	29.640	29.613	29.735	29.663	69	65	58	71	67	60	66.0	72	58	.682	.591	.456	.576
19	29.855	29.910	29.966	29.910	61	65	62	64	68	65	65.7	70	57	.497	.577	.516	.530
20	29.821	29.835	29.863	29.840	58	67	62	61	70	65	65.3	70	56	.443	.622	.516	.527
21	29.740	29.690	29.628	29.686	64	65	62	67	68	65	66.7	69	62	.556	.577	.516	.550
22	29.580	29.678	29.423	29.560	65	70	68	67	72	70	69.7	73	65	.591	.706	.658	.652
23	29.765	29.698	29.560	29.681	62	71	69	65	73	72	70.0	74	62	.516	.731	.668	.638
24	29.700	29.712	29.775	29.729	65	73	72	68	76	75	73.0	80	64	.577	.771	.744	.697
25	29.833	29.745	29.712	29.763	68	74	76	70	76	79	75.0	81	66	.658	.812	.856	.775
26	29.883	29.845	29.818	29.849	58	73	76	71	76	78	75.0	80	68	.310	.771	.870	.650
27	29.811	29.785	29.738	29.778	69	75	77	70	77	80	75.7	81	66	.695	.841	.887	.808
28	29.718	29.712	29.650	29.693	70	78	72	72	80	75	75.7	82	68	.706	.931	.744	.794
29	29.698	29.635	29.635	29.656	71	75	81	73	78	82	77.7	82	70	.731	.827	.044	.534
30	29.621	29.668	29.625	29.638	67	72	68	70	75	70	71.7	77	67	.622	.744	.658	.675
31	29.763	29.718	29.658	29.713	66	70	67	68	73	70	70.3	73	65	.612	.693	.622	.642
Means....	29.794	29.779	29.747	29.773	....	....	....	70.1	76.9	72.2	73.0	....	....	.644	.668	.574	.629
August 1	29.590	29.495	29.453	29.513	69	70	68	71	73	70	71.3	75	68	.682	.693	.658	.678
2	29.508	29.658	29.630	29.599	64	67	62	66	70	65	67.0	73	62	.569	.622	.516	.569
3	29.775	29.808	29.753	29.779	52	72	67	61	74	70	68.3	75	59	.473	.757	.622	.617
4	29.575	29.598	29.648	29.607	58	61	58	61	64	60	61.7	70	58	.443	.497	.456	.465
5	29.763	29.798	29.751	29.771	64	64	60	63	67	62	64.0	67	60	.510	.556	.491	.519
6	29.829	29.640	29.783	29.751	60	68	62	63	70	65	66.0	70	60	.478	.658	.516	.551
7	29.806	29.770	29.721	29.766	61	70	70	63	73	72	69.3	74	58	.510	.693	.706	.636
8	29,758	29.703	29.508	29.656	60	67	58	61	69	60	63.3	70	57	.505	.635	.456	.532
9	29.435	29.560	29.585	29.527	56	64	60	58	66	62	62.0	67	55	.422	.569	.491	.494
10	29.768	29.775	29.806	29.783	58	67	62	61	78	65	65.3	71	57	.443	.622	.516	.527
11	29.869	29.868	29.923	29.887	57	68	69	60	70	72	67.3	72	58	.426	.658	.668	.584
12	29.926	29.855	29.776	29.852	61	70	63	64	72	66	67.3	73	57	.497	.706	.536	.580
13	29.605	29.558	29.621	29.595	65	68	62	67	71	65	67.7	71	62	.591	.644	.516	.584
14	29.648	29.595	29.681	29.641	62	69	65	65	72	67	68.0	73	61	.516	.668	.591	.592
15	29.721	29.936	29.953	29.870	62	60	61	64	62	63	63.0	70	60	.529	.491	.510	.510
16	30.061	29.947	29.962	29.990	56	58	57	58	61	59	59.3	65	55	.422	.443	.439	.435
17	29.969	29.918	29.882	29.923	51	67	69	53	70	71	64.7	73	50	.348	.622	.682	.551
18	29.832	29.751	29.658	29.747	59	72	68	61	75	70	68.7	76	57	.473	.744	.658	.625
19	29.636	29.597	29.651	29.628	60	63	60	63	65	62	63.3	71	60	.478	.549	.491	.506
20	29.697	29.758	29.656	29.704	56	65	61	59	67	64	63.3	70	56	.409	.591	.497	.499
21	29.642	29.686	29.649	29.659	58	66	63	60	69	65	64.7	71	57	.456	.599	.549	.535
22	29.504	29.632	29.697	29.611	57	60	58	59	62	60	60.3	68	55	.439	.491	.456	.462
23	29.654	29.636	29.677	29.656	53	61	58	55	63	60	59.3	64	52	.376	.510	.456	.447
24	29.632	29.736	29.737	29.702	48	60	50	50	63	52	55.0	63	47	.309	.478	.334	.374
25	29.615	29.752	29.687	29.685	48	58	56	50	61	58	56.3	63	48	.309	.443	.422	.391
26	29.732	29.668	29.704	29.701	52	65	60	54	68	63	61.7	68	51	.362	.577	.478	.472
27	29.742	29.761	29.757	29.753	62	70	60	64	73	62	66.3	73	59	.529	.693	.491	.571
28	29.642	29.726	29.772	29.713	61	72	65	63	75	68	68.7	75	60	.510	.744	.577	.610
29	29.734	29.758	29.810	29.767	61	65	60	62	67	62	63.7	70	60	.523	.591	.491	.535
30	29.874	29.722	29.684	29.760	55	65	62	58	68	65	63.7	70	55	.393	.577	.516	.495
31	29.747	29.756	29.732	29.745	61	62	58	62	65	60	62.3	67	60	.523	.516	.456	.498
Means ...	29.719	29.723	29.720	29.721	....	....	....	60.6	68.2	64.0	64.3	....	....	.466	.601	.524	.530

the northern and northwestern lakes at Fort Niagara, New York.

VAPOR.				WIND.								Amount of cloudiness. (0 = clear sky.) (10 = sky entirely overcast.)			Amount of evaporation, in U. S. inches and decimals.	Amount of rain or melted snow, in U. S. inches and decimals.
Humidity. Saturation = 1,000.				Direction. From whence.			Velocity, in miles, per hour.			Resultant velocity, in miles, per hour.	Resultant direction.					
7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.			7 a. m.	2 p. m.	9 p. m.		
											°					
.822	.886	.825	.844	W	NW	NW	2	12	2	5.0	N. 50 W.	5	6	7	......	......
.895	.863	.848	.869	SW	W	SW	12	45	12	21.7	S. 74 W.	8	7	5	......	......
.856	.870	.890	.872	S	S	S	25	35	45	35.0	South	6	4	8	......	......
.836	.899	.880	.872	S	S	S	25	45	35	35.0	South	10	8	5	......	.44
.948	.868	.848	.888	SW	S	S	35	45	60	44.0	S. 11 W.	7	8	10	......	.18
.860	.789	.910	.853	SW	S	S	35	60	35	40.7	S. 12 W.	5	6	4	......	......
.858	.912	.903	.891	W	S	SW	25	35	45	29.0	S. 40 W.	3	5	7	......	......
.904	.860	.848	.871	S	S	NW	35	12	25	11.3	S. 31 W.	7	6	8	......	.48
.888	.893	.880	.887	N	NW	N	45	4	12	20.3	North	7	5	6	......	......
.884	.899	.893	.892	W	NE	N	4	35	4	11.7	N. 35 E.	5	6	7	......	......
.891	.862	.898	.884	W	W	W	2	4	25	10.3	West	4	6	5	......	......
.848	.874	.867	.863	W	SW	W	4	35	25	19.7	S. 65 W.	6	4	7	......	......
.862	.881	.873	.872	W	W	W	35	45	60	46.7	West	4	6	8	......	......
.952	.907	.898	.919	N	NE	NE	2	25	4	10.0	N. 42 E.	6	7	6	......	......
.858	.881	.874	.871	W	SW	S	2	35	45	24.7	S. 21 W.	6	7	8	......	......
.911	.884	.873	.889	SW	S	SW	25	45	35	32.7	S. 15 W.	7	6	8	......	......
.870	.878	.900	.883	SW	SW	S	25	60	35	37.7	S. 32 W.	6	7	10	......	1.32
.899	.893	.880	.891	W	NE	NE	25	35	60	26.7	N. 32 E.	10	10	10	......	.72
.833	.843	.836	.837	NW	NE	W	2	25	4	7.7	N. 32 E.	5	6	7	......	......
.825	.848	.836	.836	W	NE	N	2	35	25	18.0	N. 24 E.	8	7	8	......	......
.841	.843	.836	.840	W	NE	NE	4	25	45	22.3	N. 43 E.	7	9	10	......	1.03
.893	.900	.898	.897	W	W	W	2	12	35	16.3	West	10	6	10	......	.18
.836	.902	.852	.863	W	W	W	25	4	2	10.3	West	7	4	7	......	......
.843	.860	.858	.854	W	NW	NW	2	2	4	2.7	N. 58 W.	6	5	6	......	......
.898	.906	.865	.890	W	W	W	2	4	2	2.7	West	7	8	5	......	......
.408	.860	.908	.725	W	NW	NW	12	35	2	15.3	N. 56 W.	6	7	4	......	......
.948	.907	.867	.907	W	W	W	12	4	2	6.0	West	7	5	6	......	......
.900	.910	.858	.889	NW	W	W	4	12	25	13.3	N. 86 W.	4	3	6	......	......
.902	.863	.956	.907	W	W	W	4	2	2	2.7	West	4	3	5	......	.18
.848	.858	.898	.868	NW	NW	NW	45	25	35	34.0	N. 45 W.	6	5	7	......	......
.895	.854	.848	.866	NW	NW	NW	12	35	4	1.7	N. 45 W.	6	3	7	......	......
.862	.876	.874	.871	......	......	......	....	....	....	8.5	S. 59 W.	6.3	6.0	7.0	......	4.53
.899	.854	.898	.884	S	S	S	45	60	60	55.0	South	10	6	7	......	......
.891	.848	.836	.858	SW	W	W	25	60	45	41.3	S. 82 W.	6	8	7	......	......
.882	.903	.848	.878	W	SW	SW	25	35	45	33.0	S. 55 W.	5	6	9	......	1.26
.825	.833	.880	.846	SW	NW	NW	12	4	2	4.3	S. 71 W.	10	8	7	......	.54
.886	.841	.884	.870	NW	W	NW	45	35	60	44.0	N. 56 W.	5	7	8	......	......
.831	.898	.836	.855	N	W	W	35	45	45	32.3	N. 69 W.	3	5	7	......	......
.886	.854	.900	.880	W	W	NW	25	35	4	20.7	N. 88 W.	6	4	5	......	......
.941	.896	.880	.906	SW	NE	NE	2	12	35	15.0	N. 45 E.	2	7	10	......	.42
.876	.891	.884	.884	NE	W	W	60	35	45	19.0	N. 42 W.	10	7	5	......	......
.825	.848	.836	.836	W	W	W	4	2	2	2.7	West	3	5	4	......	......
.822	.898	.852	.857	W	W	W	2	12	2	5.3	West	6	4	5	......	......
.833	.900	.838	.857	W	NE	NE	4	25	12	11.7	N. 40 E.	6	10	10	......	.80
.893	.850	.836	.860	W	N	NW	2	25	12	11.7	N. 18 W.	8	9	10	......	......
.836	.852	.893	.860	W	W	W	4	12	4	6.7	West	10	6	10	......	.20
.888	.884	.886	.886	NE	N	NW	45	35	45	32.9	North	8	9	6	......	......
.876	.825	.878	.860	NE	W	W	35	2	2	10.7	N. 40 E.	7	4	5	......	......
.864	.848	.899	.870	S	W	S	2	4	12	5.0	S. 16 W.	6	4	7	......	......
.882	.858	.898	.879	S	W	S	12	2	4	5.7	S. 7 W.	6	8	9	......	......
.831	.890	.884	.868	N	NW	NW	35	12	2	15.0	N. 12 W.	10	7	8	......	.06
.819	.893	.833	.848	NW	W	SW	35	2	2	12.3	N. 50 W.	6	5	7	......	......
.880	.846	.890	.872	S	S	W	4	12	25	10.3	S. 57 W.	6	2	8	......	......
.878	.884	.880	.881	W	W	W	45	35	25	35.0	West	8	6	7	......	......
.869	.886	.880	.878	W	W	SW	4	2	12	5.7	S. 60 W.	5	8	6	......	......
.856	.831	.861	.849	W	W	W	25	35	45	35.0	West	6	4	7	......	......
.856	.825	.876	.852	W	W	W	4	12	4	6.7	West	6	3	6	......	......
.867	.843	.831	.847	SW	SW	SW	12	35	45	30.7	S. 45 W.	6	7	10	......	.04
.888	.854	.884	.875	SW	SW	SW	35	45	4	28.0	S. 45 W.	10	6	5	......	......
.886	.858	.843	.862	SW	SW	SW	2	12	4	6.0	S. 45 W.	4	8	7	......	......
.942	.893	.884	.906	NW	W	W	25	4	2	9.7	N. 53 W.	8	7	6	......	......
.816	.843	.836	.832	SW	SW	S	4	25	12	12.7	S. 32 W.	7	10	8	......	......
.942	.836	.880	.886	N	NE	NE	2	35	25	20.3	N. 44 E.	9	6	7	......	......
.870	.863	.868	.867	......	......	......	....	....	....	10.2	N. 88 W.	6.7	6.3	7.2	......	3.32

Reductions of the monthly meteorological register of the survey of

Date.	Barometer reduced to temperature of 32° Fahr., expressed in U. S. inches and decimals.				TEMPERATURE—FAHRENHEIT.									VAPOR.			
					Wet bulb, or point of evaporation.			Dry bulb, or temperature of the open air.				Maximum.	Minimum.	Elasticity, in U. S. inches and decimals.			
	7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	Mean.			7 a. m.	2 p. m.	9 p. m.	Mean.
1866.					°	°	°	°	°	°	°	°	°				
Sept. 1	29.692	29.736	29.702	29.710	60	66	62	63	69	64	65.3	71	60	.478	.599	.529	.535
2	29.564	29.596	29.739	29.630	69	79	68	71	81	70	74.0	81	69	.682	.963	.658	.768
3	29.769	29.784	29.796	29.783	64	68	65	65	71	67	67.7	72	64	.583	.644	.591	.606
4	29.867	29.766	29.624	29.752	59	66	60	61	68	63	64.0	69	59	.473	.612	.478	.521
5	29.660	29.631	29.792	29.694	66	67	62	68	70	65	67.7	70	65	.612	.622	.516	.583
6	29.853	29.847	29.837	29.846	55	70	65	57	73	67	65.7	73	55	.407	.693	.591	.564
7	29.726	29.628	29.534	29.629	57	58	56	59	60	58	59.0	68	57	.439	.456	.422	.439
8	29.617	29.676	29.792	29.695	54	58	56	57	61	58	58.7	62	54	.378	.443	.422	.414
9	29.940	30.032	30.025	29.999	54	64	61	56	67	64	62.3	69	54	.391	.556	.497	.481
10	30.030	29.987	29.867	29.961	55	62	57	55	65	60	60.0	66	54	.433	.516	.426	.458
11	29.739	29.536	29.426	29.567	60	63	59	62	65	61	62.7	65	56	.491	.549	.473	.504
12	29.382	29.434	29.760	29.525	60	67	61	62	69	64	65.0	70	60	.491	.635	.497	.541
13	29.647	29.726	29.760	29.711	55	64	56	56	66	58	56.7	67	55	.420	.569	.422	.470
14	29.702	29.659	29.744	29.702	52	65	52	55	67	54	58.7	66	52	.349	.591	.362	.401
15	29.737	30.082	30.130	30.050	46	53	47	48	56	50	51.3	57	45	.284	.363	.283	.310
16	30.105	29.947	29.823	29.958	45	55	50	48	57	53	52.7	60	45	.260	.407	321	.329
17	29.752	29.757	29.805	29.771	62	58	54	65	60	56	60.3	65	54	.516	.456	.391	.454
18	29.770	29.734	29.667	29.724	49	50	47	51	53	50	51.3	56	47	.321	.321	.283	.308
19	29.724	29.729	29.875	29.776	50	52	48	52	54	51	52.3	84	44	.334	.362	296	.331
20	29.883	29.716	29.552	29.717	48	50	46	51	53	48	50.7	53	45	.296	.321	.284	.300
21	29.564	29.724	29.887	29.725	47	48	46	49	50	48	49.0	51	45	.297	.309	.284	.297
22	29.900	30.092	29.993	29.995	42	50	48	45	52	50	49.0	53	42	.228	.334	.309	.290
23	30.076	30.101	30.066	30.081	40	53	47	42	55	50	49.0	56	39	.221	.376	.283	.293
24	30.021	29.960	30.016	30.032	45	65	52	47	68	54	56.3	69	44	.273	.577	.362	.404
25	29.955	29.719	29.702	29.792	61	51	47	63	55	50	56.0	60	47	.510	.321	.283	.371
26	29.958	30.000	29.878	29.945	50	44	45	53	47	48	49.3	55	43	.321	249	.260	.277
27	29.861	29.953	30.035	29.949	45	60	51	48	63	54	55.0	64	45	.260	.478	.335	.358
28	30.084	30.090	30.044	30.073	54	62	57	56	64	60	60.0	65	54	.391	.529	.426	.449
29	30.050	30.062	29.955	30.022	49	56	51	51	58	54	54.3	62	49	.321	.423	.335	.359
30	29.968	29.940	29.934	29.947	48	58	57	51	60	59	56.7	63	47	.296	.456	.439	.397
Means....	29.826	29.821	29.825	29.824	....	....	....	55.6	61.9	56.9	58.1	....	....	.392	.491	.402	.428
Oct. 1	29.981	29.990	29.874	29.948	50	60	58	52	63	60	58.3	64	50	.334	.478	.456	.423
2	29.787	29.669	29.647	29.701	55	70	62	58	73	65	65.3	73	55	.393	.693	.516	.534
3	29.856	29.890	29.925	29.890	45	48	45	48	50	48	48.7	65	45	.260	.309	.260	.276
4	29.852	30.060	30.176	30.029	43	44	41	46	47	44	45.7	51	41	.238	.249	.218	.235
5	30.342	30.334	30.292	30.323	37	52	42	39	54	45	46.0	55	41	.194	.362	.228	.261
6	30.201	30.219	30.108	30.176	35	54	50	37	57	52	48.7	57	34	.178	.378	.334	.297
7	30.034	29.988	29.934	29.985	55	64	58	57	66	60	61.0	67	49	.407	.569	.456	.477
8	29.858	29.860	29.770	29.829	56	65	54	59	68	61	62.7	69	56	.409	.577	.325	.437
9	29.757	29.732	29.665	29.718	55	60	54	58	62	58	59.3	65	54	.393	.491	.358	.414
10	29.737	29.764	29.865	29.789	54	59	52	57	61	55	57.7	62	53	.378	.473	.349	.400
11	29.947	29.997	29.849	29.931	51	56	52	54	58	55	55.7	61	50	.335	.422	.349	.369
12	29.787	29.732	29.854	29.791	50	52	47	52	55	50	52.3	56	47	.334	.349	.283	.322
13	29.946	29.953	30.031	29.979	50	51	49	52	54	51	52.3	55	49	.334	.335	.321	.330
14	30.157	30.125	30.154	30.145	48	52	49	50	54	51	51.7	54	48	.309	.362	.321	.331
15	30.268	30.281	30.212	30.254	51	55	53	54	58	55	55.7	59	50	.335	.393	.376	.368
16	30.279	30.232	30.355	30.289	48	60	65	51	63	67	60.3	68	48	.296	.478	.591	.455
17	29.920	29.934	29.879	29.911	47	62	58	50	65	60	58.3	66	47	.283	.516	.456	.418
18	29.864	29.825	29.881	29.857	50	63	56	52	65	58	58.3	67	49	.334	.549	.422	.435
19	29.882	29.855	29.846	29.861	56	67	62	57	70	64	63.7	70	53	.436	.622	.529	.529
20	29.969	30.023	29.864	29.952	54	61	58	56	64	60	60.0	66	54	.391	.497	.456	.448
21	29.782	29.626	29.607	29.672	60	64	65	62	71	67	66.7	71	56	.491	.503	.591	.528
22	29.375	29.414	29.657	29.482	62	59	52	65	61	55	60.3	70	52	.516	.473	.349	.446
23	29.707	29.654	29.658	29.673	42	52	42	44	55	44	47.0	56	42	.241	.349	.262	.284
24	29.691	29.855	29.957	29.834	35	40	38	38	43	45	40.3	50	35	.165	.208	.203	.192
25	29.988	30.102	30.050	30.047	36	41	37	38	44	40	40.7	43	36	.186	.218	.181	.195
26	29.864	29.825	29.881	29.857	50	63	56	52	65	58	58.3	67	49	.334	.549	.422	.435
27	29.865	30.100	30.050	30.005	38	47	42	40	50	45	45.0	50	38	.203	.283	.228	.238
28	30.070	29.987	29.870	29.976	37	48	42	39	50	44	47.3	50	37	.194	.309	.241	.248
29	29.673	29.576	29.628	29.626	49	52	48	51	54	50	51.7	55	47	.321	.362	.309	.331
30	29.516	29.583	29.654	29.584	40	44	40	43	46	43	44.0	52	40	.208	.262	.208	.259
31	29.666	29.771	29.994	29.810	36	37	35	38	40	38	38.7	45	35	.186	.181	.165	.177
Means....	29.890	29.902	29.909	29.900	....	....	....	49.6	57.6	53.0	53.4	....	....	.310	.413	.347	.357

the northern and northwestern lakes at Fort Niagara, New York.

VAPOR.				WIND.								Amount of cloudiness. (0 = clear sky.) (10 = sky entirely overcast.)			Amount of evaporation, in U. S. inches and decimals.	Amount of rain or melted snow, in U. S. inches and decimals.
Humidity. Saturation = 1,000.				Direction. From whence.			Velocity, in miles, per hour.			Resultant velocity, in miles, per hour.	Resultant direction.					
7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.			7 a. m.	2 p. m.	9 p. m.		
											°					
.831	.846	.888	.855	W	W	S	2	12	25	9.7	S. 29 W.	8	10	8	......	.58
.899	.911	.898	.903	S	S	S	12	35	45	30.7	South	9	6	8	......	.20
.944	.850	.893	.896	SW	NW	NW	12	25	4	10.7	N. 68 W.	7	8	9	......	......
.882	.895	.831	.869	S	NE	NE	2	35	25	19.7	N. 46 E.	6	7	8	......	......
.895	.848	.836	.860	S	W	W	4	45	35	27.0	S. 87 W.	8	7	9	......	.06
.874	.854	.893	.874	W	W	W	12	4	2	6.0	West	6	4	7	......	......
.878	.880	.876	.878	NW	NE	NE	4	25	12	12.7	N. 38 E.	8	10	10	......	.84
.812	.825	.876	.838	W	W	W	45	25	4	24.7	West	10	9	7	......	......
.872	.841	.833	.849	W	W	W	2	12	4	6.0	West	6	2	7	......	......
1.000	.836	.822	.886	W	W	W	2	4	4	3.3	West	5	6	7	......	......
.884	.890	.882	.885	SW	NW	NW	12	35	45	27.0	N. 34 W.	9	10	10	......	.70
.884	.896	.833	.871	SW	SW	SW	35	45	60	13.1	S. 45 W.	7	4	6	......	......
.935	.891	.876	.901	SW	W	W	25	35	25	26.3	S. 77 W.	5	6	7	......	......
.805	.893	.867	.855	W	W	W	12	45	60	39.0	West	6	7	8	......	......
.850	.809	.786	.815	NW	W	W	45	4	2	16.3	N. 50 W.	7	5	6	......	......
.777	.874	.798	.816	S	W	W	25	4	12	10.0	S. 32 W.	8	10	10	......	.66
.836	.880	.872	.863	W	W	W	45	25	45	38.3	West	10	7	8	......	.18
.859	.798	.786	.814	W	W	SW	4	25	35	19.7	S. 65 W.	10	10	9	......	......
.861	.867	.790	.839	NE	N	W	45	35	12	23.0	N. 16 E.	10	7	8	......	......
.790	.798	.850	.813	NE	N	N	35	25	45	32.6	N. 15 E.	10	10	10	......	.58
.853	.856	.850	.853	SW	W	W	35	25	12	24.0	S. 68 W.	10	7	9	......	.14
.762	.861	.856	.826	SW	W	W	35	4	2	13.0	S. 52 W.	7	5	6	......	......
.829	.869	.786	.828	W	NE	NE	4	45	25	22.3	N. 43 E.	5	6	7	......	......
.847	.843	.867	.852	SW	S	S	4	12	25	13.3	S. 4 W.	5	7	8	......	......
.886	.743	.786	.805	SW	NW	NW	2	35	60	31.7	N. 46 W.	8	10	10	......	.61
.798	.772	.777	.782	W	W	W	12	4	2	6.0	West	10	7	6	......	......
.777	.831	.802	.803	SW	W	W	12	2	4	5.7	S. 60 W.	7	4	6	......	......
.872	.888	.822	.861	S	NW	W	25	4	2	7.7	S. 12 W.	8	6	7	......	......
.859	.876	.802	.846	W	NW	NW	4	4	12	6.3	N. 53 W.	5	7	6	......	......
.790	.880	.878	.849	W	W	W	2	2	4	2.7	West	8	6	8	......	......
.855	.853	.840	.849	....	....	....	....	....	....	10.0	N. 87 W.	7.6	7.0	7.8	......	4.56
.861	.831	.880	.857	W	NW	NW	2	12	4	6.0	N. 49 W.	7	3	8	......	......
.816	.854	.836	.835	S	S	S	25	45	60	43.3	South	6	5	9	......	......
.777	.856	.770	.801	NW	W	W	60	12	4	24.0	N. 45 W.	9	6	7	......	......
.767	.772	.756	.765	NE	NW	NW	35	45	4	20.0	N. 9 W.	6	5	6	......	......
.816	.867	.762	.815	S	W	NW	4	2	25	8.0	N. 55 W.	4	6	7	......	......
.807	.812	.861	.827	SW	W	W	2	4	2	2.7	S. 80 W.	5	4	6	......	......
.874	.891	.880	.882	S	S	S	12	45	12	23.0	South	6	4	7	......	......
.819	.843	.606	.756	SW	W	S	4	2	4	2.7	S. 37 W.	8	3	8	......	......
.816	.884	.729	.796	SW	N	NW	12	35	45	23.7	N. 35 W.	8	7	10	......	.34
.812	.882	.805	.833	NE	N	SW	35	45	25	17.7	N. 8 E.	10	8	9	......	......
.802	.876	.805	.828	SW	NE	NE	25	35	45	18.3	N. 45 E.	7	6	8	......	......
.861	.805	.786	.817	NE	NE	NE	12	45	25	27.3	N. 45 E.	5	4	8	......	......
.861	.802	.859	.841	NE	NW	W	45	25	4	17.0	N. 12 E.	7	5	6	......	......
.856	.867	.859	.861	N	N	N	25	4	2	10.3	North	3	4	7	......	......
.802	.816	.869	.829	N	W	W	35	12	4	13.0	N. 25 W.	4	6	7	......	......
.790	.831	.893	.838	W	W	W	2	4	2	2.7	West	5	4	5	......	......
.786	.836	.880	.834	W	W	W	4	12	4	6.7	West	4	8	7	......	......
.861	.890	.876	.876	SW	SW	SW	12	2	4	6.0	S. 45 W.	6	4	6	......	......
.936	.848	.888	.891	S	S	S	12	45	25	27.3	South	6	7	8	......	......
.872	.833	.880	.862	NE	W	NW	12	4	12	6.0	N. 13 W.	7	4	6	......	......
.884	.863	.893	.813	S	S	S	25	60	45	43.3	South	5	8	7	......	......
.836	.882	.805	.841	S	S	S	75	60	75	70.0	South	9	6	8	......	......
.836	.805	.843	.828	S	SW	SW	12	45	35	28.7	S. 39 W.	6	7	8	......	......
.719	.750	.820	.763	SE	W	W	25	45	60	29.7	S. 79 W.	5	8	9	......	......
.811	.756	.732	.766	W	NE	NE	25	12	4	6.0	N. 50 W.	6	7	6	......	......
.861	.890	.876	.876	SW	SW	SW	12	2	4	6.0	S. 45 W.	6	4	6	......	......
.820	.786	.762	.789	S	S	S	25	35	45	35.0	South	8	7	9	......	......
.816	.856	.836	.836	NE	SE	SE	25	35	45	27.7	S. 63 E.	7	6	8	......	......
.859	.867	.856	.861	SW	SW	SW	35	12	4	17.0	S. 45 W.	10	10	10	......	.78
.750	.843	.750	.781	W	W	W	45	25	45	38.3	West	8	7	8	......	......
.811	.732	.719	.754	W	W	W	60	45	60	55.0	West	6	5	10	......	......
.826	.830	.819	.824	....	....	....	....	....	....	7.3	S. 49 W.	6.4	5.7	7.6	......	1.12

Reductions of the monthly meteorological register of the survey of

Date.	Barometer reduced to temperature of 32° Fahr., expressed in United States inches and decimals.				TEMPERATURE—FAHRENHEIT.									VAPOR			
					Wet bulb, or point of evaporation.			Dry bulb, or temperature of the open air.				Maximum.	Minimum.	Elasticity, in U. S. inches and decimals.			
	7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	Mean.			7 a. m.	2 p. m.	9 p. m.	Mean.
1866.					°	°	°	°	°	°	°	°	°				
Nov. 1	29.922	29.758	29.566	29.749	34	45	39	36	47	42	41.7	47	33	.170	.273	.199	.214
2	29.774	29.880	29.993	29.882	41	39	37	44	42	40	42.0	44	36	.218	.199	.181	.199
3	30.080	30.122	30.219	30.140	32	39	36	34	41	38	37.7	42	32	.155	.212	.186	.184
4	30.295	30.341	30.402	30.346	36	37	35	38	39	35	37.3	40	33	.186	.194	.204	.195
5	30.375	30.351	30.499	30.408	31	32	31	33	34	33	33.3	35	30	.151	.155	.151	.152
6	30.404	30.321	30.362	30.362	26	42	38	23	45	40	37.7	45	25	.117	.228	.203	.183
7	30.170	30.080	29.978	30.076	35	50	47	38	52	49	46.3	53	35	.165	.334	.297	.265
8	29.895	29.837	29.920	29.884	41	55	47	43	58	50	50.3	58	40	.231	.393	.283	.302
9	29.860	29.884	29.933	29.892	43	54	48	45	57	50	50.7	57	43	.251	.378	.309	.313
10	30.028	29.890	29.821	29.913	37	46	42	40	48	44	44.0	52	37	.181	.284	.241	.235
11	29.558	29.558	29.814	29.643	46	48	40	48	50	42	46.7	51	40	.284	.309	.221	.271
12	29.890	29.955	30.103	29.983	35	42	38	37	44	40	40.3	45	35	.178	.241	.203	.207
13	30.165	30.229	30.126	30.173	34	43	38	36	45	40	40.3	45	34	.170	.251	.203	.208
14	29.910	29.992	29.953	29.952	34	50	43	36	53	45	44.7	53	34	.170	.321	.251	.247
15	29.708	29.463	29.276	29.482	42	43	38	44	46	40	43.3	50	38	.241	.238	.203	.227
16	29.035	29.082	29.376	29.164	36	37	33	38	39	35	37.3	45	33	.186	.194	.162	.181
17	29.587	29.603	29.809	29.666	37	38	37	40	41	39	40.0	41	36	.181	.190	.194	.188
18	29.711	29.728	29.744	29.728	41	43	40	44	45	42	43.7	46	38	.218	.251	.221	.230
19	29.611	29.433	29.382	29.475	41	43	37	43	46	40	43.0	46	40	.231	.238	.181	.217
20	29.344	29.388	29.580	29.437	40	40	36	43	42	38	41.0	44	36	.208	.221	.186	.205
21	29.752	29.767	29.830	29.783	33	34	31	33	36	33	34.0	40	31	.188	.170	.151	.170
22	29.624	29.609	29.710	29.648	26	29	26	28	31	28	29.0	35	26	.117	.137	.117	.124
23	29.818	29.825	29.905	29.849	26	25	24	29	28	26	27.7	30	24	.106	.100	.106	.104
24	29.871	29.875	29.866	29.871	22	28	25	27	35	30	30.7	35	25	.061	.073	.078	.071
25	30.022	30.139	30.057	30.073	25	34	27	27	36	30	31.0	36	25	.112	.170	.113	.132
26	30.018	29.915	30.027	29.987	30	43	38	32	46	40	39.3	46	27	.144	.238	.203	.195
27	29.857	29.865	29.756	29.826	39	50	43	41	52	45	46.0	53	39	.212	.334	.251	.266
28	29.735	29.546	29.654	29.645	50	52	47	53	55	50	52.7	55	47	.321	.349	.283	.318
29	29.630	29.602	29.908	29.713	45	41	37	48	44	40	44.0	50	37	.260	.218	.181	.220
30	29.748	29.623	29.711	29.694	34	35	32	37	38	34	36.3	45	32	.157	.165	.155	.159
Means....	29.846	29.822	29.876	29.848	....	....	....	38.1	43.8	39.3	40.4	....	....	.186	.235	.197	.206
Dec. 1	30.017	30.109	30.047	30.058	27	30	27	29	32	30	30.0	35	27	.124	.144	.113	.127
2	30.084	29.897	29.974	29.985	23	35	29	25	37	32	31.3	37	23	.100	.178	.126	.135
3	29.918	30.014	29.751	29.894	30	45	39	33	48	40	40.3	48	30	.132	.260	.225	.206
4	29.453	29.382	29.647	29.494	40	40	36	42	43	38	41.0	45	36	.221	.208	.186	.205
5	29.909	30.009	30.017	29.978	32	41	38	34	44	40	39.3	44	32	.155	.218	.203	.192
6	30.032	29.957	29.746	29.912	35	40	37	38	42	40	40.0	43	35	.165	.221	.181	.189
7	29.761	29.792	29.158	29.570	40	50	42	43	52	45	46.7	53	40	.208	.334	.228	.257
8	29.203	29.118	29.306	29.209	43	49	42	46	51	45	47.3	54	42	.238	.321	.228	.262
9	29.604	29.602	29.421	29.542	25	30	23	28	32	26	28.7	34	23	.100	.144	.089	.111
10	29.556	29.533	29.716	29.602	14	20	17	16	23	20	19.7	25	14	.059	.074	.060	.064
11	29.703	29.738	29.760	29.734	16	25	18	18	27	20	21.7	34	15	.067	.112	.076	.085
12	29.860	29.810	29.989	29.890	13	19	15	15	21	17	17.7	24	13	.056	080	.063	.066
13	30.041	29.987	29.822	29.950	11	24	11	13	24	16	17.7	24	11	.049	.129	.014	.064
14	30.077	30.129	30.201	30.136	11	11	9	13	14	11	12.7	19	11	.049	.037	.043	.043
15	30.244	30.176	30.069	30.163	13	17	15	15	20	17	17.3	20	13	.056	.060	.061	.060
16	29.640	29.612	29.335	29.529	17	20	15	19	22	17	17.3	22	15	.071	.085	.063	.073
17	29.374	29.417	29.711	29.501	20	22	15	23	25	18	22.0	25	15	.074	.084	.052	.070
18	29.922	29.833	29.809	29.853	14	28	21	17	31	24	24.0	31	21	.048	.119	.079	.082
19	29.833	29.638	29.854	29.775	32	32	28	34	35	30	33.0	35	27	.155	.142	.130	.142
20	30.184	30.327	30.486	30.332	5	6	3	7	8	5	6.7	30	− 3	.032	.034	.027	.031
21	30.359	30.185	30.054	30.199	− 0	12	8	− 3	15	16	7.3	16	− 0	....	.041	.040	.040
22	29.934	29.686	29.679	29.766	27	32	25	30	35	27	30.7	35	25	.113	.142	.112	.122
23	29.445	29.311	29.978	29.245	37	40	33	40	42	36	39.3	42	33	.181	.221	.149	.184
24	29.247	29.352	29.474	29.358	34	32	27	37	35	30	34.0	31	26	.157	.142	.113	.137
25	29.557	29.654	29.742	29.651	25	24	17	28	27	20	25.0	35	17	.100	.095	.060	.085
26	29.730	29.694	29.393	29.606	16	27	21	18	30	24	24.0	32	16	.067	.113	.079	.086
27	29.324	29.428	29.448	29.400	24	23	15	27	26	17	23.3	30	15	.095	.089	.063	.082
28	29.550	29.541	29.657	29.583	12	20	15	15	23	17	18.3	25	12	.041	.074	.063	.059
29	29.803	29.834	29.853	29.830	15	17	13	18	19	15	17.3	20	13	.052	.071	.056	.060
30	30.017	30.167	30.023	30.069	13	17	10	14	19	12	15.0	19	10	.067	.071	.046	.061
31	29.929	29.828	29.993	29.917	9	24	21	12	27	24	21.0	27	9	.031	.095	.079	.068
Means....	29.784	29.766	29.746	29.765	....	....	....	24.0	29.9	24.6	26.2	....	....	.102	.132	.100	.111

the northern and northwestern lakes at Fort Niagara, New York.

VAPOR.				WIND.								Amount of cloudiness. (0=clear sky.) (10=sky entirely over-cast.			Amount of evaporation in U. S. inches and decimals.	Amount of rain or melted snow, in U. S. inches and decimals.
Humidity. Saturation = 1,000.				Direction. From whence.			Velocity, in miles, per hour.			Resultant velocity, in miles, per hour.	Resultant direction.					
7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.			7 a. m.	2 p. m.	9 p. m.		
											°					
.802	.847	.744	.798	SW ...	S	S	2	45	75	40.3	S. 1 W.	5	7	9	......	......
.756	.744	.732	.744	W	W	W	60	25	45	43.3	West ...	5	4	7	......	......
.722	.824	.811	.809	SW ...	W	W	4	4	25	10.7	S. 85 W.	6	7	9	......	......
.811	.816	1.000	.876	NE	NW ...	NW ...	60	45	35	33.0	N. 8 W.	6	7	8	......	......
.800	.792	.800	.797	N	W	W	35	12	2	12.7	N. 22 W.	6	5	7	......	......
.768	.762	.820	.783	W	W	W	12	4	12	9.3	West ...	5	4	6	......	......
.719	.861	.853	.811	SW ...	W	W	25	12	25	19.0	S. 72 W.	7	5	6	......	......
.833	.816	.786	.812	W	SW ...	SW ...	4	35	25	21.0	S. 48 W.	7	6	10	......	......
.840	.812	.856	.836	S	S	S	12	45	60	39.0	South ..	8	5	10	......	......
.732	.850	.836	.806	SW ...	NW ...	NW ...	12	4	12	6.7	N. 82 W.	4	6	8	......	.17
.850	.856	.829	.845	S	S	S	35	60	75	56.7	South ..	10	8	7	......	......
.807	.836	.820	.821	S	W	W	35	45	24	26.0	S. 63 W.	6	7	8	......	......
.802	.840	.820	.821	SW ...	NE	NE	12	25	35	16.0	N. 45 E.	7	6	9	......	......
.802	.798	.840	.813	NW ...	S	S	12	25	45	20.7	S. 8 W..	6	7	10	......	.32
.836	.767	.820	.808	SW ...	NW ...	SW ..	25	35	45	26.0	S. 72 W.	10	10	17	......	.79
.811	.816	.797	.808	W	N	W	60	75	75	51.7	N. 61 W.	10	10	10	......	.70
.732	.738	.816	.762	W	W	W	35	25	35	31.7	West ...	8	7	9	......	......
.756	.840	.829	.808	SW ...	SW ...	SW ...	45	25	12	27.3	S. 45 W.	7	6	8	......	.16
.833	.767	.732	.777	S	S	S	4	25	45	24.7	South ..	10	10	8	......	......
.750	.829	.811	.797	S	NW ...	NW ...	12	45	60	32.3	N. 50 W.	10	8	8	......	......
1.000	.802	.800	.874	W	W	W	45	60	45	50.0	West ...	7	8	9	......	......
.768	.788	.768	.771	W	NE	NE ...	25	35	60	26.7	S. 32 E.	10	10	10	......	.26
.665	.655	.754	.691	NW ...	NW ...	NW ...	25	35	25	28.3	N. 45 W.	6	7	8	......	......
.415	.359	.465	.413	NW ...	S	SW ...	12	35	25	17.3	S. 31 W.	7	6	7	......	......
.761	.802	.675	.746	W	SW ...	SW ...	4	4	12	6.3	S. 54 W.	6	7	8	......	......
.794	.767	.820	.794	SW ...	SW ...	SW ...	4	25	4	11.0	S. 45 W.	5	7	6	......	......
.824	.861	.840	.842	S	S	S	12	4	25	13.7	South ..	5	6	8	......	......
.798	.805	.786	.796	SW ...	S	S	25	35	45	33.0	S. 10 W.	7	10	10	......	.36
.777	.756	.732	.755	W	W	W	25	35	25	28.3	West ...	10	10	10	......	.62
.712	.719	.792	.741	SW ...	SW ...	SW ...	25	60	45	10.0	S. 45 W.	10	8	7	......	......
.778	.784	.793	.785	....	....	....	....	....	....	1.5	S. 64 W.	7.2	7.0	8.3	......	3.38
.775	.794	.675	.748	NW ...	NW ...	NW ...	35	25	35	31.7	N. 45 W.	8	7	8	......	......
.746	.807	.694	.749	SW ...	SW ...	SW ...	4	25	12	13.7	S. 45 W.	6	4	6	......	......
.703	.777	.910	.797	S	S	S	35	45	35	38.3	South ..	5	4	6	......	.42
.829	.750	.811	.797	NE ...	W	S	25	35	45	10.7	S. 32 W.	10	10	10	......	.48
.792	.756	.820	.789	SW ...	SW ...	SW ...	12	4	2	6.0	S. 45 W.	6	7	8	......	......
.719	.829	.732	.760	NE	NE	W	4	25	12	17.3	N. 23 E.	7	6	10	......	......
.750	.861	.762	.791	S	S	S	4	12	35	17.0	South ..	7	6	8	......	......
.767	.859	.762	.796	S	SW ...	SW ...	4	90	90	60.7	S. 44 W.	10	10	9	......	.40
.655	.794	.634	.694	W	SW ...	S	45	12	75	33.3	S. 33 W.	7	10	10	......	.20
.659	.598	.556	.604	W	W	W	60	25	35	40.0	West ...	7	6	7	......	......
.682	.761	.702	.715	SW ...	SW ...	SW ...	25	45	25	31.7	S. 45 W.	6	7	10	......	......
.648	.712	.571	.677	SW ...	SW ...	S	4	35	45	26.0	S. 21 W.	6	5	8	......	......
.623	1.000	.164	.596	SW ...	SW ...	SW ...	25	12	35	24.0	S. 45 W.	4	6	9	......	......
.623	.457	.596	.559	NW ...	NW ...	NW ...	35	45	35	38.3	N. 45 W.	8	8	9	......	......
.648	.556	.671	.625	SW ...	S	SW ...	4	12	25	12.7	S. 32 W.	6	7	8	......	......
.692	.721	.671	.695	NE	NE ...	NE ...	75	60	75	70.0	N. 45 E.	10	10	10	......	.34
.598	.622	.525	.582	NW ...	NW ...	NW ...	45	60	45	50.0	N. 45 W.	10	10	8	......	......
.509	.685	.610	.601	W	W	W	4	2	12	6.0	West ...	6	4	6	......	......
.792	.698	.782	.757	SW ...	S	S	4	25	35	20.7	S. 2 W.	7	10	10	......	.12
.538	.553	.500	.530	NE	NE	S	60	25	45	20.7	N. 76 E.	10	10	8	......	......
......	.475	.582	.529	S	S	S	12	4	4	6.7	South ..	7	6	7	......	......
.675	.698	.761	.711	S	S	S	2	12	25	13.0	South ..	6	7	6	......	......
.732	.829	.705	.755	S	S	S	35	45	25	35.0	South ..	10	10	10	......	.10
.712	.698	.675	.695	SW ...	SW ...	SW ...	35	25	35	31.7	S. 45 W.	10	8	10	......	......
.655	.644	.556	.618	W	W	W	60	45	60	55.0	West ...	10	7	10	......	.06
.682	.675	.610	.656	S	SW ...	SW ...	4	12	35	16.7	S. 42 W.	6	5	10	......	......
.644	.634	.671	.650	W	NW ...	NW ...	60	75	90	71.0	N. 56 W.	7	6	8	......	......
.475	.598	.671	.581	W	W	W	75	60	75	70.0	West ...	6	7	8	......	......
.525	.692	.648	.622	W	W	W	75	60	45	60.0	West ...	6	5	8	......	......
.816	.692	.610	.706	SW ...	SW ...	W	4	12	4	6.3	S. 53 W.	6	7	6	......	......
.418	.644	.610	.557	W	W	W	2	4	12	6.0	West ...	7	6	8	......	......
.669	.705	.656	.675	....	....	....	....	....	....	19.6	S. 72 W.	7.3	7.1	8.3	......	2.12

Reductions of the monthly meteorological register of the survey of

Date.	Barometer reduced to temperature of 32° Fahr., expressed in United States inches and decimals.				TEMPERATURE—FAHRENHEIT.									VAPOR.			
					Wet bulb, or point of evaporation.			Dry bulb, or temperature of the open air.				Maximum.	Minimum.	Elasticity, in U. S. inches and decimals.			
	7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	Mean.			7 a. m.	2 p. m.	9 p. m.	Mean.
1866.					°	°	°	°	°	°	°	°	°				
July 1	29.991	29.955	29.914	29.953	61	69	62	69	78	68	71.7	80	41	.430	.588	.476	.498
2	29.982	29.954	29.833	29.923	60	75	68	65	83	72	80.0	83	52	.451	.760	.631	.614
3	29.758	29.676	29.575	29.670	66	73	70	71	87	76	78.0	88	51	.572	.623	.652	.616
4	29.513	29.442	29.533	29.496	64	69	66	69	77	69	71.7	78	51	.529	.601	.599	.576
5	29.728	29.656	29.623	29.669	68	80	69	75	87	73	78.3	88	55	.591	.928	.655	.725
6	29.767	29.658	29.687	29.671	72	85	74	78	90	79	82.3	91	62	.704	.135	.772	.537
7	29.707	29.725	29.617	29.683	71	71	74	79	90	79	82.7	91	64	.651	.502	.772	.645
8	29.642	29.574	29.681	29.632	74	75	65	81	83	70	78.0	84	61	.745	.760	.550	.685
9	29.895	29.921	29.944	29.920	55	62	63	64	72	68	68.0	73	50	.314	.422	.509	.415
10	30.009	29.937	29.911	29.952	59	66	61	66	77	69	67.3	79	43	.407	.492	.430	.443
11	29.902	30.067	29,818	29.929	60	69	71	65	77	74	72.0	81	49	.451	.601	.718	.623
12	29.813	29.743	29.780	29.779	69	78	74	76	90	78	81.3	91	53	.614	.677	.785	.692
13	29.707	29.595	29.569	29.624	73	78	79	79	94	82	85.0	95	63	.730	.741	.949	.807
14	29.743	29.707	29.700	29.717	67	75	69	73	82	74	76.3	94	61	.581	.773	.641	.665
15	29.737	29.685	29.674	29.699	77	81	77	83	94	84	87.0	96	62	.846	.880	.832	.853
16	29.813	29.734	29.707	29.748	80	87	72	87	97	79	87.7	98	69	.928	.146	.690	.588
17	29.869	29.660	29.652	29.727	76	82	71	85	96	77	86.0	97	68	.775	.902	.678	.785
18	29.592	29.605	29.641	29.613	72	68	63	77	72	66	71.7	79	54	.718	.631	.536	.628
19	29.786	29.805	29.807	29.799	58	66	63	64	74	67	68.3	76	49	.403	.532	.522	.486
20	29.870	29.847	29.721	29.813	56	70	65	62	78	70	70.0	79	47	.369	.625	.550	.515
21	29.684	29.647	29.565	29.632	60	67	67	65	78	72	71.7	78	53	.451	.514	.595	.520
22	29.511	29.540	29.465	29.505	64	72	67	66	77	72	71.7	76	56	.569	.718	.595	.627
23	29.546	29.592	29.623	29.587	63	69	65	68	76	68	70.7	77	54	.509	.614	.577	.567
24	29.731	29.684	29.658	29.691	61	70	69	66	79	75	73.0	82	55	.470	.612	.628	.570
25	29.715	29.687	29.703	29.702	66	72	68	72	82	73	75.7	84	55	.559	.650	.618	.609
26	29.834	29.786	29.810	29.810	63	76	73	68	85	76	76.3	86	53	.509	.775	.771	.685
27	29.789	29.686	29.583	29.686	65	76	68	70	86	73	76.3	86	54	.550	.762	.618	.643
28	29.656	29.549	29.538	29.581	62	71	69	68	81	75	74.7	82	56	.476	.624	.628	.576
29	29.513	29.559	29.483	29.518	68	65	65	72	81	69	74.0	80	55	.631	.403	.564	.533
30	29.541	29.560	29.606	29.576	63	64	65	70	77	68	71.7	78	55	.482	.556	.577	.538
31	29.676	29.702	29.621	29.666	64	66	65	68	80	70	72.7	80	55	.543	.586	.550	.569
Means....	29.743	29.708	29.676	29.709	....	....	....	71.6	82.6	72.7	75.6	....	....	.566	.617	.635	.606
August 1	29.511	29.420	29.428	29.453	65	70	71	70	74	75	73.0	76	55	.550	.679	.704	.644
2	29.446	29.493	29.504	29.481	64	64	60	68	73	65	68.7	75	55	.543	.476	.451	.490
3	29.641	29.692	29.616	29.650	65	63	64	70	76	68	71.3	78	49	.550	.402	.543	.498
4	29.511	29.526	29.502	29.513	63	60	59	66	64	61	63.7	67	51	.536	.463	.473	.491
5	29.656	29.678	29.662	29.632	61	58	59	67	66	61	64.7	67	46	.457	.376	.473	.435
6	29.702	29.680	29.798	29.727	55	63	61	58	74	67	66.3	74	47	.393	.429	.457	.426
7	29.731	29.725	29.704	29.720	56	67	63	66	75	65	68.7	76	46	.316	.554	.549	.473
8	29.742	29.627	29.446	29.605	53	71	62	58	78	68	68.0	77	45	.336	.664	.476	.492
9	29.377	29.511	29.534	29.474	55	64	60	60	70	65	65.0	70	50	.367	.516	.451	.445
10	29.682	29.718	29.748	29.716	57	64	62	62	74	67	67.7	74	46	.399	.462	.489	.450
11	29.858	....	29.857	29.858	54	....	63	59	....	66	62.5	72	46	.351	....	.536	.444
12	29.852	29.745	29.738	29.778	61	64	66	65	75	71	70.3	81	45	.483	.449	.572	.501
13	29.594	29.513	29.276	29.461	62	69	65	65	73	68	68.7	74	54	.516	.635	.577	.583
14	29.546	29.696	28.659	29.634	64	64	60	67	68	63	66.0	70	52	.556	.543	.478	.526
15	28.756	29.837	29.925	29.839	60	55	55	64	62	60	62.0	71	48	.465	.340	.367	.391
16	29.999	29.977	29.802	29.926	50	54	54	55	62	58	58.2	66	43	.295	.312	.365	.324
17	29.944	29.810	29.771	29.842	50	64	59	57	76	66	66.3	75	37	.268	.436	.407	.370
18	29.728	29.670	29.611	29.670	60	68	64	67	76	70	71.0	80	46	.425	.577	.516	.506
19	29.494	29.471	29.482	29.482	60	61	58	65	65	62	64.0	69	50	.451	.483	.429	.454
20	29.517	29.636	29.601	29.585	53	60	55	56	67	61	61.3	70	45	.363	.425	.354	.381
21	29.587	29.566	29.512	29.555	51	61	58	56	68	61	61.7	73	42	.308	.443	.443	.398
22	29.482	29.558	29.580	29.540	54	59	54	58	66	55	59.7	65	45	.365	.407	.404	.392
23	29.553	29.529	29.457	29.513	47	55	52	50	63	56	56.3	63	37	.283	.327	.335	.315
24	29.608	29 586	29.657	29.617	45	55	53	48	66	56	56.7	68	37	.260	.300	.363	.308
25	29.668	29.706	29.677	29.684	45	55	54	48	63	56	55.7	65	35	.260	.327	.391	.326
26	29.695	29.661	29.696	29.684	53	63	57	57	70	63	63.3	71	45	.350	.482	.386	.406
27	29.696	29.627	29.623	29.649	57	69	67	63	82	69	71.3	83	47	.386	.534	.635	.518
28	29.692	29.645	29.548	29.628	53	73	62	58	76	69	67.7	80	47	.509	.771	.462	.581
29	29.636	29.620	29.699	29.652	59	73	63	64	78	63	68.3	79	46	.433	.744	.576	.584
30	29.695	29.663	29.659	29.639	49	62	59	53	69	63	61.7	73	41	.295	.462	.447	.401
31	29.722	29.665	29.585	29.657	54	66	62	58	72	76	68.7	74	47	.365	.545	.369	.426
Means....	29.653	29.621	29.621	29.641	....	....	....	60.6	68.4	64.3	65.1	....	....	.401	.471	.464	.451

the northern and northwestern lakes at Charlotte, New York.

VAPOR.				WIND.									Amount of cloudiness. (0 = clear sky.) (10 = sky entirely overcast.)			Amount of evaporation, in U. S. inches and decimals.	Amount of rain or melted snow, in U. S. inches and decimals.
Humidity. Saturation = 1,000.				Direction. From whence.			Velocity, in miles, per hour.			Resultant velocity, in miles, per hour.	Resultant direction.						
7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.			7 a. m.	2 p. m.	9 p. m.		
											°					
.607	.613	.695	.638	S	E	S	12	4	2	5.0	S. 19 E.	2	4	0	......	......
.731	.673	.804	.736	W.NW	S	S	2	12	4	5.3	S. 7 W.	10	10	3	......	......
.754	.486	.727	.656	S	S	S	25	45	4	24.7	South	4	8	2	......	......
.747	.648	.846	.747	S	SW.	S	12	35	2	15.3	S. 33 W.	10	6	10	......	......
.681	.724	.807	.737	S	SW.	S	12	2	4	6.0	S. 5 W.	0	10	8	......	.28
.734	.805	.779	.773	SW	SW.	SW.	12	25	12	16.3	S. 45 W.	8	5	0	......	.04
.657	.357	.779	.598	SW	W.SW.	SW.	12	12	25	16.0	S. 51 W.	4	4	3	......	......
.704	.673	.751	.708	SW.	SW	SW	35	25	4	21.0	S. 53 W.	5	10	4	......	......
.527	.539	.743	.603	N.	N.NE.	N.	12	12	2	8.7	N. 9 E.	10	7	7	......	......
.636	.531	.607	.591	N.NE.	NE.	N.	4	12	4	6.7	N. 33 E.	0	2	2	......	......
.731	.648	.856	.745	S SE.	NW.	S	2	25	25	6.3	S. 59 W.	1	4	0	......	......
.685	.545	.819	.683	SW	W	SW	12	12	25	15.7	S. 55 W.	3	2	0	......	......
.738	.464	.870	.687	W	W	S	12	25	25	15.0	S. 56 W.	3	7	7	......	......
.716	.708	.764	.729	NE.	E.NE.	S	4	25	4	9.0	N. 71 E.	6	4	3	......	......
.750	.552	.714	.672	SW.	SW.	SW	4	12	25	13.7	S. 45 W.	10	1	0	......	......
.724	.654	.697	.692	W	W	S	12	35	4	16.0	S. 85 W.	2	2	1	......	......
.644	.532	.731	.636	SW.	W	NW.	12	25	12	14.0	West	5	3	10	......	......
.774	.804	.838	.806	W	N	N.	4	45	35	27.0	N. 3 W.	10	10	10	......	......
.675	.634	.790	.703	N.	N	SW	4	4	2	2.3	N. 12 W.	4	7	8	......	......
.665	.653	.751	.690	SE	E.	SW	4	4	2	2.3	S. 55 W.	9	10	0	......	......
.731	.537	.758	.675	S	E	E	2	12	12	8.3	S. 85 E.	8	9	4	......	......
.891	.774	.758	.808	W	NE.	S	2	12	2	3.0	N. 45 E.	8	4	10	......	......
.743	.685	.843	.757	NW.	NW	N	12	35	2	16.3	N. 43 W.	10	3	2	......	.40
.735	.618	.724	.692	SW.	N	SW.	12	12	2	3.3	N. 78 W.	6	3	2	......	......
.712	.595	.761	.689	SW.	N.	W	4	4	2	1.7	N. 75 W.	5	3	1	......	......
.743	.644	.860	.749	NW	N.	S	2	12	2	4.0	N. 6 W.	0	8	8	......	......
.751	.613	.761	.708	W	N.	SW.	2	25	2	8.0	N. 9 W.	2	3	2	......	......
.695	.590	.724	.670	N.NW.	N.	S	4	12	2	4.8	N. 8 W.	6	2	2	......	......
.804	.382	.796	.661	NW	N.	SW.	25	25	2	15.3	N. 25 W.	2	4	2	......	......
.658	.841	.843	.781	N.	N.	N.	25	12	2	13.0	North	9	3	1	......	......
.793	.799	.751	.781	NE.	NE.	S	2	12	4	3.7	N. 59 E.	1	4	4	......	......
.714	.623	.772	.703	......	......	......	....	....	....	6.2	S. 52 W.	5.3	5.2	3.7	......	1.02
.751	.810	.812	.791	S	S	S	12	35	12	19.7	South	10	10	10	......	......
.793	.588	.731	.704	S	W	W	12	35	35	24.0	S. 80 W.	2	8	6	......	.10
.751	.448	.793	.664	N.	N.	NW.	12	12	12	11.8	N. 15 W.	10	10	10	......	.02
.838	.780	.882	.833	S	SW.	S	4	45	12	19.0	S. 34 W.	10	2	2	......	1.38
.690	.588	.882	.720	W	W.NW	W	25	35	2	20.3	N. 77 W.	4	10	10	......	.65
.816	.511	.690	.672	W	NW.	W	12	60	4	24.0	N. 54 W.	5	2	0	......	.29
.495	.639	.890	.675	W	N.NW.	W	12	25	2	11.0	N. 45 W.	2	4	0	......	......
.698	.693	.695	.695	S	W	S	2	2	4	2.3	S. 17 W.	3	10	10	......	......
.708	.704	.731	.714	NE.	N.NW.	N.	60	25	12	28.0	N. 23 E.	10	7	6	......	.21
.718	.551	.740	.670	N.	NW	W	12	25	2	11.7	N. 33 W.	2	3	7	......	.08
.703	......	.838	.770	W	......	W	2	....	2	1.3	West	0	....	0	......	......
.783	.518	.754	.685	E.SE.	N.	S	12	35	2	10.3	N. 21 E.	5	10	10	......	......
.836	.807	.843	.829	SE.	SE	SE	25	25	35	25.0	S. 45 E.	10	7	8	......	.57
.841	.793	.831	.822	SE	N.	N.	4	12	12	7.3	N. 7 E.	10	10	7	......	.14
.780	.612	.708	.700	N	N.	NE.	25	25	25	23.3	N. 14 E.	10	10	5	......	......
.681	.561	.756	.666	N.NE.	N.	S	25	12	2	11.7	N. 16 E.	3	0	0	......	......
.577	.486	.636	.566	W	N.NW.	SW.	2	12	12	5.3	N. 81 W.	0	0	3	......	......
.642	.644	.701	.663	SW	N	N	12	4	12	3.7	N. 47 W.	2	7	8	......	......
.731	.783	.772	.762	E.SE.	W.SW.	N	4	12	25	6.7	N. 23 W.	10	10	3	......	......
.809	.642	.659	.703	N.	N.	S	4	12	2	4.7	North	3	3	1	......	.34
.687	.647	.825	.720	SW.	N.	SW.	4	12	2	3.0	N. 28 W.	9	4	2	......	.02
.756	.636	.934	.775	W	W	W	12	35	2	16.3	West	5	5	10	......	.02
.786	.568	.747	.700	NW	N.	SW.	2	12	4	3.7	N. 23 W.	10	4	3	......	......
.777	.487	.809	.691	W	W	S	4	12	4	5.7	S. 76 W.	2	6	6	......	.09
.777	.568	.872	.739	W.SW.	NW	W	2	12	2	5.0	N. 58 W.	2	4	1	......	......
.752	.658	.670	.693	S	SW.	SE	25	35	25	22.7	S. 6 W.	9	8	8	......	......
.670	.489	.896	.685	SE	SW	S	25	4	2	9.0	S. 33 E.	8	3	1	......	.02
.743	.860	.653	.752	S.SW.	SE	S	12	2	2	5.0	S. 13 W.	3	10	10	......	......
.727	.776	1.000	.834	S	S	SW	2	4	2	2.7	S. 10 W.	10	2	3	......	......
.733	.653	.776	.721	W	NE.	S	2	4	2	0.3	N. 45 E.	7	8	10	......	......
.756	.672	.412	.613	S	E	E	4	25	12	12.7	S. 84 E.	10	10	6	......	......
.735	.618	.772	.717	......	......	......	....	....	....	2.9	N. 57 W.	6.0	6.0	5.3	......	3.93

Reductions of the monthly meteorological register of the survey of

Date.	Barometer reduced to temperature of 32° Fahr., expressed in United States inches and decimals.				TEMPERATURE—FAHRENHEIT.									VAPOR.			
					Wet bulb, or point of evaporation.			Dry bulb, or temperature of the open air.				Maximum.	Minimum.	Elasticity, in U. S. inches and decimals.			
	7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	Mean.			7 a. m.	2 p. m.	9 p. m.	Mean.
1866.					°	°	°	°	°	°	°	°	°				
Sept. 1	29.631	....	29.445	29.538	63	...	69	66	....	72	69.0	89	54	.536	....	.668	.602
2	29.493	29.461	29.683	29.546	69	77	68	73	84	73	76.7	86	61	.655	.832	.618	.702
3	29.757	29.738	29.681	29.725	55	70	62	60	75	66	67.0	75	49	.367	.666	.502	.512
4	29.734	29.678	29.546	29.653	61	70	64	65	75	68	69.3	77	52	.483	.666	.543	.564
5	29.593	29.598	29.654	29.615	64	66	59	69	75	64	69.3	75	53	.529	.519	.433	.494
6	29.670	29.740	29.792	29.734	50	65	59	55	74	64	64.3	74	42	.295	.497	.433	.408
7	29.742	29.549	29.512	29.601	54	60	59	58	63	62	61.0	64	45	.365	.478	.460	.434
8	29.494	29.619	29.617	29.577	57	60	52	61	63	56	60.0	64	45	.412	.478	.335	.408
9	29.865	....	29.861	29.863	55	....	54	60	....	58	59.0	68	42	.367	....	.365	.366
10	29.917	29.838	29.802	29.852	48	64	55	52	69	58	59.0	67	40	.282	.556	.393	.410
11	29.622	29.318	29.281	29.407	55	65	66	58	67	70	65.0	70	45	.393	.577	.586	.519
12	29.286	29.285	29.311	29.294	60	65	61	64	72	66	67.3	72	52	.465	.524	.470	.486
13	29.521	29.628	29.674	29.608	60	65	60	66	70	61	65.7	70	44	.438	.550	.505	.498
14	29.695	29.536	29.590	29.607	48	61	51	53	67	55	58.3	67	42	.269	.457	.321	.349
15	29.981	30.024	30.053	30.019	40	48	43	43	57	46	52.0	57	34	.208	.217	.238	.221
16	29.925	29.785	29.757	29.822	45	58	56	49	63	60	57.3	63	31	.247	.416	.396	.353
17	29.626	29.664	29.702	29.664	60	59	52	64	64	58	62.0	65	46	.465	.433	.309	.402
18	29.683	29.645	29.597	29.642	50	51	53	54	56	56	55.3	60	44	.308	.308	.363	.326
19	29.613	29.645	29.615	29.624	51	51	50	54	53	53	53.3	55	43	.335	.348	.321	.335
20	29.775	29.558	29.482	29.605	51	54	55	53	67	58	59.3	58	42	.348	.378	.393	.373
21	29.467	29.668	29.676	29.604	56	47	47	60	52	49	53.7	64	38	.396	.257	.297	.317
22	29.848	30.039	30.060	29.982	42	49	43	48	55	47	50.0	55	33	.189	.269	.225	.228
23	29.928	30.001	29.814	29.914	44	52	49	48	58	53	53.0	59	26	.236	.309	.295	.280
24	29.923	29.824	29.794	29.847	43	61	57	46	68	61	58.3	68	34	.238	.443	.412	.364
25	29.807	29.655	29.699	29.720	58	66	61	63	71	63	65.7	73	50	.416	.572	.510	.499
26	29.852	29.874	29.904	29.877	49	50	40	50	53	42	48.3	63	34	.335	.321	.221	.292
27	29.913	29.985	29.950	29.949	42	56	50	46	63	51	53.3	65	31	.215	.356	.348	.306
28	30.050	29.969	29.952	30.997	47	63	52	51	69	54	58.0	70	36	.270	.495	.362	.376
29	30.082	29.974	29.998	30.018	46	64	55	49	67	59	58.3	73	35	.271	.556	.380	.402
30	29.901	29.859	29.896	29.885	55	59	53	58	65	56	59.7	67	35	.393	.420	.363	.392
Means....	29.746	29.672	29.713	29.726	....	....	....	56.5	61.1	58.6	60.2	....	....	.357	.430	.402	.407
Oct. 1	29.932	29.878	29.789	29.866	50	63	59	54	73	63	63.3	74	39	.308	.442	.447	.399
2	29.705	....	29.518	29.612	52	....	63	57	....	67	62.0	80	47	.322	....	.522	.422
3	29.786	29.803	29.757	29.782	45	47	37	49	53	41	47.7	66	30	.247	.244	.168	.220
4	29.614	30.032	30.078	29.908	39	43	40	42	49	44	45.0	50	29	.199	.199	.195	.198
5	30.329	30.227	30.168	29.241	36	49	41	40	57	44	47.0	56	20	.160	.242	.218	.207
6	30.192	30.167	30.030	30.130	37	53	44	39	62	47	49.3	68	25	.194	.224	.249	.242
7	29.970	29.857	29.789	29.872	44	70	60	47	76	63	62.0	76	34	.249	.632	.478	.460
8	29.843	29.783	29.784	29.803	58	68	62	61	74	64	66.3	76	49	.443	.604	.529	.525
9	29.826	29.728	29.741	29.765	52	61	63	56	66	66	62.7	67	45	.335	.470	.536	.447
10	29.834	29.796	29.862	29.831	52	59	55	57	64	58	59.7	67	46	.322	.433	.393	.383
11	29.887	29.804	29.765	29.819	49	61	50	52	68	53	57.7	66	42	.308	.443	.321	.357
12	29 804	29.757	20.740	29.767	39	55	53	42	58	55	51.7	60	31	.199	.393	.376	.323
13	29.818	29.865	29.701	29.795	50	52	43	62	58	47	52.3	50	35	.334	.309	.225	.289
14	30.012	29.974	30.012	29.999	47	50	47	50	56	50	52.0	55	30	.283	.282	.283	.283
15	30.027	30.127	30.060	30.071	49	53	46	52	63	51	55.3	61	34	.308	.270	.245	.274
16	30.123	30.059	29.878	30.020	43	56	55	46	65	59	56.7	68	33	.238	.330	.380	.316
17	29.877	29.784	29.769	29.810	49	59	58	52	65	63	60.0	68	40	.308	.420	.416	.381
18	29.875	29.813	29.745	29.811	45	66	53	49	74	57	60.0	75	38	.247	.532	.350	.376
19	29.823	29.767	29.750	29.780	50	64	62	54	77	68	66.3	77	40	.308	.422	.476	.402
20	29.921	29.836	29.809	29.855	54	65	65	58	71	65	64.7	76	40	.365	.537	.617	.506
21	29.752	29.620	29.551	29.641	56	68	65	62	77	70	69.7	77	46	.369	.564	.550	.494
22	29.336	29.591	29.553	29.493	62	58	49	68	65	63	65.3	77	43	.476	.389	.295	.387
23	29.596	29.520	29.564	29.560	39	53	42	45	55	45	48.3	55	33	.160	.376	.228	.255
24	29.590	29.639	29.707	29.645	33	40	38	36	43	41	40.9	49	24	.149	.208	.190	.182
25	29.907	29.968	29.942	29.939	33	40	35	37	43	35	38.3	44	25	.136	.208	.204	.183
26	29.798	29.712	....	29.755	33	40	....	37	43	....	26.7	....	....	.136	.208	....	.172
27	29.752	29.855	29.988	29.865	37	45	41	43	48	44	45.0	50	22	.142	.260	.218	.207
28	30.022	29.933	29.724	29.893	39	42	42	43	46	46	45.0	46	31	.186	.215	.215	.202
29	29.658	29.530	29.410	29.533	48	52	52	52	55	55	54.0	55	37	.282	.349	.349	.329
30	29.394	29.401	29.394	29.396	43	43	44	46	47	46	46.3	55	35	.238	.225	.262	.242
31	29.588	29.730	29.765	29.694	35	36	33	37	40	36	37.7	46	24	.178	.160	.149	.162
Means....	29.822	29.828	29.778	29.805	....	....	....	48.9	59.7	53.4	53.5	....	....	.262	.356	.336	.317

the northern and northwestern lakes at Charlotte, New York.

VAPOR.				WIND.								Amount of cloudiness. (0=clear sky.) (10=sky entirely overcast.)			Amount of evaporation, in U. S. inches and decimals.	Amount of rain or melted snow, in U. S. inches and decimals.
Humidity. Saturation = 1,000.				Direction. From whence.			Velocity, in miles, per hour.			Resultant velocity, in miles, per hour.	Resultant direction.					
7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.			7 a. m.	2 p. m.	9 p. m.		
											°					
.838	.....	.852	.845	S	.....	S	4	....	25	9.7	South	2	....	4	......	.03
.807	.714	.761	.761	S	SW	W	12	25	25	17.3	S. 45 W.	10	8	2	......	.16
.708	.768	.786	.754	S	E	W	4	12	2	3.7	S. 67 E.	3	10	6	......	......
.783	.768	.793	.781	NE	NE	S	2	12	2	4.0	N. 49 E.	1	1	0	......	......
.747	.599	.727	.691	S	NW	SW	4	25	4	7.7	N. 62 W.	10	4	4	......	......
.681	.593	.727	.667	SW	W.NW.	W	4	25	2	9.3	N. 76 W.	2	2	0	......	.33
.756	.831	.828	.805	S. SW.	E	E	2	4	35	12.7	S. 88 E.	9	10	10	......	......
.769	.831	.747	.782	NW	NW	NW	4	12	2	6.0	N. 45 W.	10	9	0	......	1.06
.708	.....	.756	.721	NW	.....	NW	12	....	2	4.7	N. 45 W.	2	....	0	......	.03
.727	.841	.816	.795	NW	S. SW.	SE	2	12	2	4.0	S. 22 W.	0	3	0	......	......
.816	.843	.799	.819	SE	SE	SE	2	4	4	2.7	S. 80 E.	10	10	10	......	......
.780	.668	.735	.728	SW	SW	SW	35	45	25	35.0	S. 45 W.	5	10	4	......	.41
.685	.751	.941	.792	SW	W	S	12	45	2	18.0	S. 79 W.	2	6	10	......	......
.667	.690	.743	.700	S. SW.	N. NE.	W	4	4	35	11.7	West	7	6	2	......	......
.750	.465	.767	.661	W	W	W	12	25	2	13.0	West	9	5	0	......	.12
.710	.723	.765	.733	S	SE	S	25	12	2	12.0	S. 18 E.	10	10	10	......	......
.780	.727	.641	.716	S	NW	SE	35	25	2	8.3	S. 41 W.	8	10	10	......	.24
.738	.687	.809	.745	NW	NE	NE	4	12	25	12.7	N. 39 E.	10	10	10	......	.35
.802	.844	.798	.821	N	N	N	41	25	25	31.7	North	10	10	8	......	.21
.864	.812	.816	.831	E	E	E	45	25	4	24.7	East	10	10	10	......	.12
.765	.660	.853	.759	W	N. NW.	S	25	35	4	16.0	N. 53 W.	10	10	10	......	.17
.563	.620	.698	.627	W	W	W	4	2	2	2.7	West	8	1	4	......	.04
.704	.641	.733	.695	SE	NE	E. NE	25	45	12	21.0	N. 73 E.	7	4	2	......	......
.767	.647	.769	.728	S	S	S	12	12	35	19.7	South	0	7	10	......	......
.723	.754	.886	.788	SE	SE	SE	12	12	2	8.7	S. 45 W.	10	10	10	......	......
.927	.798	.829	.851	N	NW	S	45	25	2	23.0	N. 16 W.	10	10	10	......	.60
.691	.619	.929	.746	W	N	S	4	12	12	1.3	West	0	2	0	......	.10
.722	.700	.867	.763	S	S	S	4	12	4	6.7	South	0	2	0	......	......
.781	.841	.761	.798	SW	N	SW	4	4	4	2.0	S. 75 W.	2	9	2	......	......
.816	.680	.809	.768	N	N	SW	12	12	12	6.0	N. 29 W.	4	8	0	......	......
.753	.671	.791	.755	......	......	......	....	....	....	2.8	S. 40 W.	6.0	3.5	4.9	......	3.97
.738	.545	.776	.686	SW	E. SE.	SE	4	12	4	5.0	S. 47 E.	10	7	0	......	......
.692	.....	.790	.741	S	.....	W.SW.	12	....	12	6.7	S. 34 W.	2	....	7	......	......
.710	.606	.653	.656	NE	N	W	45	25	4	21.0	N. 26 E.	10	1	5	......	......
.744	.572	.677	.664	SE	N	N	12	35	35	20.7	N. 8 E.	9	3	3	......	......
.645	.521	.756	.641	S. SE.	NE	S	4	12	2	3.7	N. 79 E.	0	4	0	......	......
.816	.511	.772	.700	S	E	S	25	12	4	10.7	S. 22 E.	0	0	0	......	......
.772	.727	.831	.777	S	S. SW.	SW	4	25	12	13.3	S. 27 W.	4	3	0	......	......
.825	.720	.888	.811	SW	NW	W	4	4	2	2.5	West	2	5	0	......	......
.747	.735	.838	.773	SW	NE	N	2	45	25	21.0	N. 29 E.	2	5	2	......	......
.692	.727	.816	.745	E	SE	SE	25	35	25	29.3	S. 61 E.	9	10	3	......	......
.794	.647	.798	.746	E	E	E	12	2	2	5.0	East	5	10	0	......	......
.744	.816	.869	.810	E	E. NE.	N	4	12	12	7.3	N. 43 E.	5	9	8	......	......
.861	.641	.698	.733	N	NE	SW	60	25	2	26.0	N. 12 E.	10	2	0	......	......
.786	.627	.786	.733	N. NE.	NW	W	45	35	2	22.3	N. 8 W.	2	0	0	......	......
.794	.470	.653	.639	NW	NW	NW	35	12	2	16.3	N. 45 W.	0	0	0	......	......
.767	.535	.761	.688	N	N	N	2	2	2	2.0	North	0	0	0	......	......
.794	.680	.723	.732	W	W	W	2	4	2	2.7	West	2	7	3	......	......
.710	.634	.752	.699	NW	N	S	25	2	2	8.3	N. 45 W.	0	2	0	......	......
.738	.456	.695	.630	S	SW	S	25	25	12	19.0	S. 18 W.	4	7	0	......	......
.756	.708	1.000	.821	SW	E	E	4	4	2	1.3	S. 52 E.	4	8	4	......	......
.665	.608	.751	.675	S	S	S	25	2	2	9.7	South	2	10	7	......	......
.695	.631	.733	.686	S	SW	NW	35	45	4	24.3	S. 28 W.	4	1	0	......	......
.533	.869	.762	.721	S	SW	SW	4	35	35	24.3	S. 43 W.	4	7	10	......	......
.705	.750	.738	.731	SW	SW	SW	12	4	60	25.3	S. 45 W.	7	10	10	......	......
.619	.750	1.000	.790	N	N	SW	12	12	2	7.3	N. 4 W.	10	6	1	......	.02
.619	.750	.....	.689	E	SE	.....	45	12	....	18.0	S. 81 E.	10	10	....	......	......
.511	.777	.756	.681	SW	W	N	25	12	35	11.3	N. 60 W.	8	10	10	......	.10
.669	.691	.691	.684	E	E	E	25	25	25	25.0	East	10	10	10	......	.14
.727	.805	.805	.779	S	S	S	25	12	2	13.0	South	10	10	10	......	.05
.767	.698	.843	.769	NW	NW	NW	12	35	35	27.0	N. 45 W.	10	10	10	......	.95
.807	.645	.705	.719	NW	NW	NW	25	45	12	27.3	N. 45 W.	10	8	6	......	.08
.724	.662	.777	.721	......	......	......	....	....	....	1.4	N. 25 W.	5.3	5.8	3.5	......	1.34

Reductions of the monthly meteorological register of the survey of

Date.	Barometer reduced to temperature of 32° Fahr., expressed in United States inches and decimals.				TEMPERATURE—FAHRENHEIT.									VAPOR.			
					Wet bulb, or point of evaporation.			Dry bulb, or temperature of the open air.				Maximum.	Minimum.	Elasticity, in U. S. inches and decimals.			
	7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	Mean.			7 a. m.	2 p. m.	9 p. m.	Mean.
1866.					°	°	°	°	°	°	°	°	°				
Nov. 1	29. 858	29. 681	29. 476	29. 672	33	42	42	37	47	49	44. 3	49	22	. 136	. 202	. 175	. 171
2	29. 681	29. 832	29. 840	29. 784	43	39	37	47	43	40	43. 3	49	29	. 225	. 186	. 181	. 197
3	30. 022	30. 044	30. 004	30. 023	32	38	35	35	42	38	38. 3	42	24	. 142	. 177	. 165	. 161
4	30. 194	30. 255	30. 269	30. 239	34	34	34	38	38	36	37. 3	40	25	. 144	. 144	. 170	. 153
5	30. 420	30. 457	30. 389	30. 422	29	33	27	32	37	29	32. 7	39	18	. 126	. 136	. 124	. 129
6	30. 450	30. 343	30. 162	30. 318	23	42	32	25	51	34	36. 7	37	17	. 100	. 149	. 155	. 135
7	30. 071	29. 913	29. 878	29. 954	30	52	41	32	60	43	45. 0	60	18	. 144	. 282	. 230	. 219
8	29. 730	29. 789	29. 745	29. 755	36	53	48	40	63	53	52. 0	62	22	. 160	. 270	. 269	. 233
9	29. 833	29. 827	29. 738	29. 799	47	55	48	50	63	52	55. 0	63	37	. 283	. 327	. 282	. 297
10	29. 852	....	29. 722	29. 787	40	....	40	43	....	43	43. 0	53	33	. 208	....	. 208	. 208
11	29. 438	29. 473	29. 552	29. 488	47	47	40	52	50	43	48. 3	52	33	. 257	. 283	. 208	. 249
12	29. 815	29. 883	29. 986	29. 895	35	42	39	38	46	41	41. 7	49	26	. 165	. 215	. 212	. 197
13	30. 100	30. 084	30. 064	30. 083	44	45	36	47	52	38	45. 7	53	25	. 249	. 207	. 186	. 214
14	29. 910	29. 801	29. 681	29. 797	34	44	43	36	51	47	44. 7	52	23	. 170	. 196	. 225	. 197
15	29. 554	29. 293	29. 076	29. 308	43	50	54	46	53	57	52. 0	57	32	. 238	. 321	. 378	. 312
16	28. 947	28. 965	29. 035	28. 982	38	38	35	41	42	38	40. 3	56	27	. 190	. 177	. 165	. 177
17	29. 350	29. 462	29. 560	29. 457	37	39	38	40	42	40	40. 7	43	28	. 181	. 199	. 203	. 194
18	29. 597	29. 628	29. 624	29. 616	39	45	43	41	48	46	45. 0	48	31	. 212	. 260	. 238	. 237
19	29. 522	29. 368	29. 328	29. 406	41	47	45	43	52	48	47. 7	52	32	. 231	. 257	. 260	. 249
20	29. 231	29. 276	29. 364	29. 290	44	41	40	47	45	42	44. 7	51	33	. 249	. 205	. 221	. 225
21	29. 500	29. 560	29. 565	29. 542	34	32	32	36	35	34	35. 0	42	22	. 170	. 142	. 155	. 156
22	29. 566	29. 468	29. 483	29. 506	28	31	32	30	33	35	32. 7	35	17	. 130	. 151	. 142	. 141
23	29. 693	29. 611	29. 701	29. 668	30	28	27	31	31	28	30. 0	33	16	. 155	. 119	. 136	. 137
24	29. 784	29. 708	29. 638	29. 710	26	30	32	27	33	33	31. 0	33	16	. 129	. 132	. 168	. 143
25	29. 964	30. 068	29. 918	29. 983	26	32	23	27	33	24	28. 0	34	15	. 129	. 168	. 112	. 136
26	29. 931	29. 814	29. 833	29. 859	26	40	33	28	45	35	36. 0	44	14	. 117	. 182	. 169	. 154
27	29. 869	29. 825	29. 683	29. 792	36	48	44	40	53	47	46. 7	54	23	. 160	. 269	. 249	. 226
28	29. 635	29. 410	29. 397	29. 481	48	54	53	53	59	56	56. 0	59	38	. 269	. 351	. 363	. 328
29	29. 385	29. 371	29. 348	29. 368	52	46	45	57	50	48	51. 7	57	37	. 322	. 258	. 260	. 280
30	29. 445	29. 450	29. 423	29. 439	35	37	33	38	40	35	37. 7	46	25	. 165	. 181	. 162	. 169
Means....	29. 745	29. 712	29. 683	29. 714	....	....	....	39. 9	46. 1	41. 0	42. 1	....	....	. 185	. 212	. 205	. 201
Dec. 1	29. 836	29. 836	29. 803	29. 825	29	27	28	30	30	31	30. 3	37	18	. 149	. 113	. 119	. 127
2	29. 906	29. 929	29. 923	29. 919	28	33	29	30	39	31	33. 3	38	18	. 130	. 110	. 137	. 126
3	29. 917	29. 801	29. 714	29. 811	24	40	35	26	47	42	38. 3	41	14	. 106	. 156	. 113	. 125
4	29. 286	29. 254	29. 426	29. 322	40	43	42	45	45	45	45. 0	49	32	. 182	. 251	. 228	. 220
5	29. 825	29. 922	30. 000	29. 916	33	45	34	34	50	36	40. 0	50	23	. 175	. 234	. 170	. 193
6	30. 034	29. 861	29. 732	29. 876	35	39	37	38	43	39	40. 0	43	21	. 165	. 186	. 194	. 182
7	29. 766	29. 793	29. 672	29. 744	42	48	37	45	54	39	46. 0	53	26	. 228	. 256	. 194	. 226
8	29. 176	29. 139	29. 177	29. 164	49	49	46	53	56	49	52. 7	55	25	. 295	. 255	. 271	. 274
9	29. 391	29. 332	29. 418	29. 380	29	34	29	32	39	33	34. 7	48	20	. 126	. 131	. 114	. 124
10	29. 548	29. 630	29. 623	29. 600	16	19	15	18	21	16	18. 3	35	3	. 067	. 080	. 074	. 074
11	29. 761	29. 774	29. 783	29. 773	16	23	18	17	27	20	21. 3	27	3	. 078	. 078	. 076	. 077
12	29. 781	29. 795	29. 803	29. 793	15	21	18	17	28	20	20. 0	23	5	. 063	. 090	. 076	. 076
13	29. 905	29. 809	29. 815	29. 843	17	24	21	19	25	23	22. 3	25	7	. 071	. 117	. 090	. 093
14	30. 135	30. 167	30. 180	30. 161	11	10	9	12	11	10	11. 0	23	2	. 061	. 057	. 054	. 057
15	30. 271	30. 108	30. 065	30. 181	15	20	21	17	22	23	20. 7	23	3	. 063	. 085	. 090	. 079
16	29. 725	29. 557	29. 475	29. 586	17	20	21	19	22	23	21. 3	27	7	. 071	. 085	. 090	. 082
17	29. 489	29. 597	29. 666	29. 584	24	24	28	25	26	30	27. 0	30	8	. 117	. 106	. 130	. 118
18	29. 937	29. 882	29. 781	29. 867	24	33	26	26	35	28	29. 7	34	15	. 106	. 162	. 117	. 128
19	29. 812	29. 738	29. 968	29. 839	32	35	31	33	37	33	34. 3	36	16	. 168	. 178	. 151	. 166
20	30. 291	30. 404	30. 348	30. 348	5	8	10	6	9	11	08. 7	32	–6	. 043	. 051	. 057	. 050
21	30. 354	30. 116	29. 916	30. 129	–11	14	15	–10	14	15	06. 3	17	–22	. 014	. 082	. 086	. 061
22	29. 949	29. 730	29. 610	29. 730	28	34	34	29	36	36	33. 7	37	5	. 142	. 170	. 170	. 161
23	29. 282	29. 120	28. 975	29. 126	37	41	40	39	44	42	41. 7	43	25	. 194	. 218	. 221	. 211
24	29. 242	29. 272	29. 338	29. 284	37	35	31	39	39	33	37. 0	44	23	. 194	. 152	. 151	. 166
25	29. 428	29. 483	29. 581	29. 497	31	33	26	33	35	28	32. 0	35	15	. 151	. 162	. 117	. 143
26	29. 750	....	29. 393	29. 572	19	....	29	21	....	31	26. 0	31	10	. 080	....	. 137	. 109
27	29. 341	29. 327	29. 317	29. 328	26	25	20	28	26	22	25. 3	31	12	. 117	. 123	. 085	. 108
28	29. 361	29. 365	29. 628	29. 451	16	18	17	17	19	18	18. 0	20	10	. 078	. 087	. 083	. 083
29	30. 236	29. 753	29. 788	29. 926	18	19	17	19	20	18	19. 0	21	5	. 087	. 092	. 083	. 087
30	29. 902	29. 765	30. 001	29. 889	17	21	17	18	23	17	19. 3	23	5	. 083	. 090	. 094	. 089
31	29. 896	29. 861	29. 851	29. 869	13	26	27	15	28	28	23. 7	29	–1	. 056	. 117	. 136	. 103
Means....	29. 756	29. 701	29. 702	29. 720	....	....	....	25. 5	31. 5	27. 8	28. 3	....	....	. 118	. 136	. 126	. 126

the northern and northwestern lakes at Charlotte, New York.

VAPOR.				WIND.								Amount of cloudiness. (0 = clear sky.) (10 = sky entirely overcast.)			Amount of evaporation, in U. S. inches and decimals.	Amount of rain or melted snow, in U. S. inches and decimals.
Humidity. Saturation = 1,000.				Direction. From whence.			Velocity, in miles, per hour.			Resultant velocity, in miles, per hour.	Resultant direction.					
7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.			7 a. m.	2 p. m.	9 p. m.		
											°					
.619	.624	.505	.583	S	S	S	35	35	35	35.0	South	10	10	10	......	......
.698	.669	.732	.700	NW	W	S	2	25	2	8.7	S. 89 W.	10	10	10	......	......
.698	.661	.719	.693	N	N.NW	W	2	12	4	5.3	N. 33 W.	7	10	10	......	......
.628	.628	.802	.686	N.NW	NW	N	12	4	35	16.3	N. 9 W.	10	11	10	......	......
.694	.619	.775	.696	N	N	W	35	25	12	20.7	N. 12 W.	10	3	0	......	......
.746	.399	.792	.646	W	W	W	4	12	2	6.0	West	0	0	0	......	......
.794	.546	.833	.724	SW	W	S	4	25	12	10.3	S. 62 W.	3	10	0	......	......
.645	.470	.667	.594	SW	SW	SW	4	12	12	9.3	S. 45 W.	3	5	11	......	......
.786	.568	.727	.694	W	W	W	12	35	35	27.3	West	3	0	0	......	......
.750	......	.750	.750	W	......	S	12	....	4	4.3	S. 72 W.	0	....	10	......	......
.660	.786	.750	.732	S	W	SW	35	4	25	19.0	S. 22 W.	10	10	10	......	.21
.719	.691	.824	.745	SW	N	NW	4	25	12	11.0	N. 21 W.	2	9	10	......	.04
.772	.535	.811	.706	NW	NE	N	12	12	2	6.3	North	8	3	2	......	......
.802	.525	.698	.675	E	SE	S	25	4	12	10.3	S. 62 E.	8	10	10	......	......
.767	.798	.812	.792	SE	SE	SE	25	12	45	27.3	S. 45 E.	10	10	10	......	.28
.738	.661	.719	.706	W	W.SW.	W	45	35	45	41.0	S. 84 W.	10	10	10	......	.90
.732	.744	.820	.765	NW	NW	NW	25	12	2	13.0	N. 45 W.	8	10	10	......	.33
.824	.777	.767	.789	S.SW	SW	W	12	4	2	5.7	S. 35 W.	10	10	10	......	.02
.833	.660	.777	.753	SE	SE	SE	4	12	4	6.7	S. 45 E.	10	10	10	......	.07
.772	.684	.829	.762	SE	W	W	45	12	12	10.7	S. 14 E.	9	9	10	......	.18
.802	.698	.792	.764	NW	W	N	45	25	25	26.7	N. 45 W.	10	10	10	......	.12
.782	.800	.698	.760	NE	NE	NE	12	25	60	32.3	N. 45 E.	10	10	10	......	......
.893	.685	.883	.820	NE	W	N	35	12	12	13.0	N. 19 E.	10	10	10	......	.13
.880	.703	.893	.825	W	W	W	25	12	45	27.3	West	10	10	10	......	.03
.880	.893	.868	.880	N	N	S	45	2	12	11.7	North	10	4	10	......	.01
.768	.607	.797	.724	S	S	S	12	12	12	12.0	South	9	3	0	......	......
.645	.667	.772	.695	S	S	S	12	12	12	12.0	South	8	9	10	......	......
.667	.703	.809	.726	S	S	S	12	12	4	9.3	South	10	10	10	......	......
.692	.716	.777	.728	SW	SW	SW	12	12	4	9.3	S. 45 W.	10	10	10	......	.60
.719	.732	.797	.749	W	W	N	12	45	35	22.3	N. 59 W.	10	6	10	......	.43
.747	.664	.773	.729	....	....	....	....	....	....	4.9	S. 86 W.	7.9	7.7	8.1	......	3.35
.890	.675	.685	.750	NW	NW	NW	45	35	12	30.7	N. 45 W.	8	8	10	......	......
.782	.463	.788	.678	SW	SW	S	4	4	4	3.7	S. 30 W.	10	7	0	......	......
.754	.483	.420	.552	S.SW	SE	S	2	12	12	8.0	S. 19 E.	5	2	10	......	......
.607	.840	.762	.736	SE	W.SW.	SW	35	12	35	18.7	S. 12 W.	10	10	10	......	.25
.895	.646	.802	.781	W	W	W	2	4	2	2.7	West	4	4	0	......	.32
.719	.669	.816	.735	E.SE	E	W	12	12	4	6.7	S. 77 E.	10	10	10	......	......
.762	.613	.816	.730	W	W	W	4	4	2	3.3	West	0	2	0	......	......
.733	.569	.781	.694	S	SW	NW	45	60	45	31.0	S. 53 W.	10	4	10	......	......
.694	.547	.606	.616	S	S	S	12	12	12	12.0	South	2	3	2	......	.19
.682	.712	.829	.741	S	SW	W	25	12	12	13.0	S. 31 W.	9	1	0	......	.08
.834	.529	.702	.688	SW	SW	SW	12	2	12	8.7	S. 45 W.	10	10	10	......	......
.671	.730	.702	.701	SW	SW	SW	12	25	25	20.7	S. 45 W.	2	10	5	......	......
.692	.872	.730	.765	W	W	W	25	4	4	11.0	West	5	10	10	......	......
.804	.797	.791	.797	N	W	W	25	12	12	11.7	N. 44 W.	10	10	10	......	......
.671	.721	.730	.707	W	W	E	12	4	12	1.3	West	10	10	10	......	......
.692	.721	.730	.714	E	E	E	45	60	45	5.0	East	10	10	10	......	......
.872	.754	.782	.803	N	NW	N.NW.	35	25	35	30.3	N. 20 W.	10	10	10	......	1.00
.754	.797	.768	.773	NW	S	SW	12	2	35	12.7	N. 61 W.	10	10	10	......	.40
.893	.807	.800	.833	SW	SW	SW	12	4	35	17.0	S. 45 W.	10	10	10	......	......
.760	.784	.797	.780	NE	N	SE	45	2	25	17.3	N. 72 E	10	9	10	......	.16
.539	1.000	1.000	.846	S.SE	SE	S	2	12	25	12.3	S. 15 E.	4	0	2	......	......
.887	.802	.802	.830	SE	SE	SE	35	25	25	28.3	S. 45 E.	10	10	10	......	......
.816	.756	.829	.800	S	S	S	4	12	12	9.3	South	10	10	10	......	.10
.816	.636	.800	.751	SW	SW	SW	25	12	25	20.7	S. 45 W.	10	10	8	......	.20
.800	.797	.768	.788	SW	SW	SW	12	12	35	19.7	S. 45 W.	10	10	10	......	......
.712	......	.788	.750	W	......	SE	2	....	43	14.3	S. 43 E.	3	....	10	......	......
.768	.876	.721	.788	W	W	N.NW.	45	60	60	46.7	N. 67 W.	10	10	10	......	.10
.834	.845	.840	.840	N.NW.	W	W	60	45	45	42.0	N. 64 W.	10	10	10	......	.41
.845	.850	.840	.845	SW	SW	SW	45	12	12	23.0	S. 45 W.	10	10	10	......	.48
.840	.730	1.000	.857	SW	SW	SW	12	2	12	8.7	S. 45 W.	10	10	10	......	......
.648	.768	.883	.766	SE	SE	S	12	12	2	8.7	S. 41 E.	7	10	10	......	......
.763	.726	.778	.756	....	....	....	....	....	....	6.3	S. 52 W.	8.0	7.7	7.9	......	3.69

Reductions of the monthly meteorological register of the survey of

Date.	Barometer reduced to temperature of 32° Fahr., expressed in United States inches and decimals.				TEMPERATURE—FAHRENHEIT.									VAPOR.			
					Wet bulb, or point of evaporation.			Dry bulb, or temperature of the open air.				Maximum.	Minimum.	Elasticity, in U. S. inches and decimals.			
	7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	Mean.			7 a. m.	2 p. m.	9 p. m.	Mean.
1866.					°	°	°	°	°	°	°	°	°				
July 1	29.977	29.999	29.939	29.972	54	61	64	59	71	70	66.7	75	49	.351	.403	.516	.423
2	29.984	29.903	29.798	29.895	60	70	68	66	78	74	72.7	78	51	.438	.625	.604	.556
3	29.878	29.667	29.587	29.711	66	73	71	73	83	79	78.3	84	67	.545	.677	.651	.624
4	29.505	29.390	29.438	29.444	67	67	65	73	72	69	71.3	78	65	.581	.595	.564	.580
5	29.630	29.657	29.638	29.642	65	72	68	70	78	73	73.7	78	62	.550	.704	.618	.624
6	29.655	29.654	29.618	29.642	71	73	69	77	80	75	77.3	81	69	.678	.717	.628	.674
7	29.644	29.634	29.600	29.626	70	72	70	76	81	76	77.7	82	68	.652	.663	.652	.656
8	29.588	29.560	29.620	29.589	72	71	68	76	75	73	74.7	77	69	.731	.704	.618	.684
9	29.801	29.889	29.881	29.857	60	63	64	66	71	71	69.3	74	60	.438	.469	.503	.470
10	29.999	29.953	29.901	29.951	58	69	67	63	77	72	70.7	78	55	.416	.601	.595	.537
11	29.916	29.877	29.798	29.864	62	68	67	66	78	74	72.7	78	59	.502	.550	.568	.540
12	29.808	29.707	29.638	29.718	66	71	70	71	80	78	76.3	80	66	.572	.637	.625	.611
13	29.647	29.627	29.567	29.614	69	73	74	74	82	80	78.7	83	66	.641	.690	.758	.696
14	29.695	29.730	29.698	29.708	68	69	70	73	78	78	76.3	88	68	.618	.588	.625	.610
15	29.728	29.674	29.654	29.685	72	76	72	76	85	80	80.3	85	69	.631	.775	.677	.694
16	29.754	29.739	29.699	29.729	73	78	74	77	88	81	82.0	88	73	.757	.823	.745	.775
17	29.734	29.679	29.627	29.680	74	76	74	78	85	81	81.3	87	74	.785	.775	.745	.768
18	29.605	29.538	29.584	29.576	69	63	61	74	67	65	68.7	80	60	.641	.522	.483	.549
19	29.764	29.799	29.783	29.782	55	62	64	59	72	70	67.0	73	55	.380	.422	.516	.439
20	29.864	29.797	29.730	29.797	57	68	69	62	77	75	71.3	75	54	.399	.564	.628	.530
21	29.751	29.642	29.590	29.661	62	68	67	66	77	74	72.3	79	62	.502	.564	.568	.545
22	29.553	....	29.458	29.506	62	....	71	67	....	77	72.0	81	62	.489	....	.768	.629
23	29.428	29.500	29.578	29.502	65	67	66	69	75	72	72.0	76	64	.564	.554	.559	.559
24	29.691	29.697	29.660	29.683	61	72	68	67	81	73	73.7	82	59	.457	.663	.618	.579
25	29.671	29.670	29.685	29.675	65	73	70	69	81	76	75.3	82	64	.564	.703	.652	.640
26	29.778	29.769	29.738	29.762	63	71	70	67	82	77	75.3	83	62	.522	.610	.639	.590
27	29.732	29.694	29.617	29.681	67	73	72	71	85	80	78.7	85	66	.824	.650	.677	.717
28	29.585	29.534	29.490	29.503	70	70	68	75	78	72	75.0	81	68	.666	.625	.631	.641
29	29.513	29.474	29.455	29.481	61	70	67	68	80	75	74.3	82	62	.443	.598	.554	.532
30	29.528	29.544	29.585	29.552	64	68	64	69	80	74	74.3	80	65	.529	.524	.462	.505
31	29.783	29.670	29.643	29.699	60	68	66	65	80	73	72.7	81	59	.451	.524	.545	.507
Means....	29.716	29.689	29.655	29.686	....	....	....	69.7	78.6	74.7	74.3	....	....	.558	.617	.613	.596
Aug. 1	29.518	29.412	29.375	29.435	64	70	67	71	78	72	73.7	78	65	.503	.625	.595	.574
2	29.388	29.425	29.458	29.424	69	67	65	73	74	70	72.3	74	66	.655	.568	.550	.591
3	29.625	29.678	29.658	29.654	63	66	64	68	75	70	71.0	75	62	.509	.519	.516	.515
4	29.541	29.444	29.559	29.515	62	60	57	65	64	61	63.3	69	57	.516	.465	.412	.498
5	29.626	29.613	29.604	29.614	57	61	59	63	67	66	65.3	67	56	.386	.457	.407	.417
6	29.621	29.638	29.623	29.627	60	65	66	66	70	70	68.7	71	59	.438	.550	.586	.525
7	29.691	29.663	29.673	29.676	60	65	65	66	72	69	69.0	72	65	.438	.524	.564	.509
8	29.708	29.652	29.528	29.629	58	67	64	62	75	70	69.0	75	57	.429	.554	.516	.500
9	29.406	....	29.504	29.455	59	....	60	63	....	63	63.0	70	59	.447	....	.478	.463
10	29.658	29.705	29.721	29.695	57	64	60	61	72	65	66.0	72	53	.412	.489	.451	.451
11	29.814	....	29.869	29.842	58	....	62	62	....	67	64.5	75	55	.429	....	.489	.459
12	29.914	29.807	29.765	29.829	56	71	69	60	81	75	72.0	81	54	.396	.624	.628	.549
13	29.716	29.656	29.631	29.668	60	63	62	66	70	68	68.0	74	61	.438	.482	.476	.465
14	29.604	29.588	29.573	29.588	61	68	66	66	72	70	69.3	72	62	.470	.631	.586	.562
15	29.718	29.799	29.910	29.809	61	56	55	65	62	60	62.3	69	55	.483	.369	.367	.406
16	30.000	29.937	29.930	29.956	47	55	58	51	64	63	59.0	65	46	.270	.314	.416	.333
17	29.987	29.821	29.761	29.823	55	61	62	59	70	68	65.7	70	49	.380	.416	.476	.424
18	29.748	29.691	29.626	29.688	64	65	64	68	70	68	68.7	71	63	.543	.550	.543	.545
19	29.554	29.478	29.469	29.500	61	61	57	65	66	61	64.0	67	58	.483	.470	.412	.455
20	29.584	29.591	29.591	29.589	54	63	60	58	71	65	64.7	71	53	.365	.469	.451	.428
21	29.600	29.553	29.521	29.558	53	64	60	58	72	65	65.0	72	52	.336	.489	.451	.425
22	29.392	29.458	29.524	29.458	59	60	53	63	66	59	62.7	66	54	.447	.438	.323	.403
23	29.527	29.496	29.474	29.499	53	58	56	57	65	62	61.3	65	52	.350	.389	.369	.369
24	29.569	29.561	29.612	29.581	52	59	55	57	65	62	61.3	66	51	.322	.420	.340	.361
25	29.689	29.686	29.654	29.676	54	58	56	58	65	62	61.7	65	54	.365	.389	.369	.371
26	29.642	29.588	29.556	29.595	55	60	60	60	69	66	65.0	69	55	.367	.398	.438	.401
27	29.601	29.621	29.628	29.617	60	65	63	64	72	68	68.0	73	60	.465	.524	.509	.499
28	29.661	29.645	29.628	29.645	61	70	65	67	77	69	71.0	78	59	.457	.639	.564	.553
29	29.618	29.580	29.586	29.595	64	68	62	68	75	66	69.7	75	62	.543	.591	.502	.545
30	29.641	29.655	29.614	29.637	57	63	60	60	70	64	64.7	70	55	.426	.482	.465	.458
31	29.701	29.703	29.686	29.597	57	65	61	61	72	66	66.3	72	55	.412	.524	.470	.469
Means....	29.644	29.626	29.623	29.631	....	....	....	62.9	70.3	66.1	66.3	....	....	.435	.495	.475	.469

the northern and northwestern lakes at Sackett's Harbor, New York.

VAPOR.				WIND.								Amount of cloudiness. (0 = clear sky.) (10 = sky entirely overcast.)			Amount of evaporation, in U. S. inches and decimals.	Amount of rain or melted snow, in U. S. inches and decimals.
Humidity. Saturation = 1,000.				Direction. From whence.			Velocity, in miles, per hour.			Resultant velocity, in miles, per hour.	Resultant direction.					
7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.			7 a. m.	2 p. m.	9 p. m.		
											°					
.703	.532	.704	.646	S	W	S	4	4	2	2.3	S. 21 W.	0	0	2	......	......
.685	.653	.720	.686	S	S	S	4	4	2	3.3	South	6	9	10	......	......
.672	.600	.657	.643	S	SW	SE	4	12	2	5.0	S. 28 W.	5	7	6	......	......
.716	.758	.796	.757	S	S	SW	4	35	25	19.7	S. 17 W.	5	10	6	......	.02
.751	.734	.761	.749	S	SW	S	12	4	4	6.3	S. 8 W.	5	8	10	......	.26
.731	.701	.724	.719	S	SW	SW	12	25	4	12.7	S. 32 W.	10	3	0	......	......
.727	.627	.727	.694	S	W	SW	12	12	4	7.0	S. 45 W.	0	7	3	......	......
.815	.812	.761	.796	S	SW	S	4	12	4	6.3	S. 27 W.	10	10	5	......	.18
.685	.618	.663	.655	NE	NE	W	12	25	2	12.0	N. 43 E.	6	5	0	......	.24
.723	.648	.758	.710	Calm	W	Calm	0	4	0	1.3	West	0	0	0	......	......
.786	.574	.677	.679	S	SW	SW	2	12	4	6.0	S. 40 W.	3	4	3	......	......
.754	.623	.653	.677	S	SW	SW	12	12	25	15.7	S. 35 W.	4	2	0	......	......
.764	.632	.741	.716	SW	W	Calm	12	4	0	5.0	S. 56 W.	0	9	10	......	......
.761	.613	.653	.676	NE	NE	Calm	12	2	0	4.7	N. 45 E.	8	6	9	......	......
.815	.644	.661	.707	S	SW	SW	2	12	12	8.7	S. 43 W.	7	2	4	......	.22
.817	.622	.704	.714	SW	SW	S	4	4	4	3.7	S. 30 W.	5	3	9	......	......
.819	.644	.704	.722	SW	SW	S	4	12	12	8.7	S. 26 W.	7	5	8	......	......
.764	.790	.783	.779	S	NE	NE	4	35	35	22.3	N. 47 E.	10	10	9	......	......
.761	.539	.704	.668	NE	NE	N	4	12	4	6.3	N. 37 E.	8	5	4	......	......
.718	.608	.724	.683	SE	W	S	2	2	2	1.3	S. 10 W.	5	8	6	......	.22
.786	.608	.677	.690	SE	W	Calm	4	4	0	1.0	S. 23 W.	7	5	3	......	......
.740	......	.731	.736	E	......	Calm	4	....	0	1.3	East	7	....	9	......	......
.796	.639	.712	.716	NW	N	SE	12	25	2	11.0	N. 13 W.	10	7	0	......	......
.690	.627	.761	.693	S	W	S	2	12	2	4.3	S. 72 W.	1	2	1	......	.20
.796	.665	.727	.729	S	W	Calm	4	4	0	2.0	S. 45 W.	7	6	0	......	......
.790	.559	.689	.679	SE	W	Calm	2	4	0	1.0	S. 62 W.	0	5	6	......	......
.608	.540	.661	.606	Calm	W	S	0	4	4	2.0	S. 45 W.	2	5	10	......	......
.768	.653	.804	.742	W	NW	S	2	12	2	4.0	N. 57 W.	9	8	1	......	......
.647	.585	.639	.624	NE	W	W	4	12	2	4.0	N. 77 W.	0	4	2	......	.16
.747	.512	.551	.603	SE	W	NE	2	12	12	2.7	N. 15 W.	9	6	1	......	......
.731	.512	.672	.638	NE	W	S	4	12	2	3.0	N. 85 W.	0	4	9	......	......
.744	.629	.706	.694	......	......	......	....	....	....	2.1	S. 40 W.	5.0	5.5	4.7	......	1.50
.663	.653	.758	.691	S	SW	S	12	25	12	15.0	S. 23 W.	10	10	10	......	......
.807	.677	.751	.745	S	SW	W	12	35	45	26.3	S. 62 W.	6	3	5	......	1.72
.743	.599	.704	.682	W	W	W	25	25	25	25.0	West	3	2	10	......	......
.836	.780	.769	.795	E	NE	NE	4	45	2	16.7	N. 48 E.	10	10	8	......	.74
.670	.690	.636	.665	NW	NW	NW	12	35	25	24.0	N. 45 W.	8	10	10	......	1.28
.685	.751	.799	.745	NW	W	SW	12	12	4	8.0	N. 76 W.	9	10	8	......	.16
.685	.668	.796	.716	W. by N	SW	N	25	25	2	14.7	S. 76 W.	0	7	0	......	.40
.772	.639	.704	.705	Calm	SW	Calm	0	12	0	4.0	S. 45 W.	0	8	10	......	......
.776	......	.831	.804	NE	......	NE	12	....	2	4.7	N. 45 E.	10	....	5	......	.16
.769	.624	.731	.708	N	SW	S	2	4	2	1.3	S. 45 W.	7	5	0	......	.22
.772	......	.740	.756	SW	......	Calm	2	....	0	0.7	S. 45 W.	0	....	0	......	......
.765	.590	.724	.696	E	S	SE	2	4	2	2.0	S. 34 E.	3	8	10	......	......
.685	.658	.695	.679	SE	S	SE	4	12	2	5.7	S. 16 E.	10	10	10	......	.12
.735	.804	.799	.779	SE	S	SW	4	25	2	9.7	S. 3 E.	10	10	10	......	.16
.783	.665	.708	.752	NE	NE	NE	25	25	12	20.7	N. 45 E.	10	10	2	......	.14
.722	.527	.723	.657	NE	SW	W	12	12	4	1.3	West	3	0	0	......	......
.761	.570	.695	.675	SW	SW	SW	4	12	4	6.7	S. 45 W.	0	0	4	......	......
.793	.751	.793	.779	SW	S	Calm	12	12	0	7.3	S. 23 W.	9	10	10	......	......
.783	.735	.769	.762	E	NE	NE	4	25	25	17.7	N. 48 E.	10	10	10	......	.02
.756	.618	.731	.702	NE	SW	W	4	12	12	6.0	S. 71 W.	1	5	7	......	.14
.698	.624	.731	.684	SE	SW	S	4	12	2	5.0	S. 22 W.	9	5	1	......	......
.776	.685	.647	.703	SW	SW	SW	25	45	12	27.3	S. 45 W.	10	7	4	......	.40
.752	.631	.665	.683	S	SW	NW	4	12	4	5.0	S. 50 W.	10	4	8	......	.10
.692	.680	.612	.661	NW	W	W	4	45	35	27.7	N. 88 W.	9	5	6	......	......
.756	.631	.665	.684	W	W	W	25	25	12	20.7	West	5	3	4	......	......
.708	.564	.685	.652	S	SW	SW	12	25	35	23.0	S. 38 W.	8	5	7	......	......
.780	.668	.743	.730	S	S	S	25	12	2	13.0	South	9	7	10	......	......
.690	.689	.796	.725	S	SW	S	4	12	4	6.3	S. 28 W.	2	5	10	......	......
.793	.681	.786	.753	SW	SW	SW	2	4	4	3.3	S. 45 W.	10	7	6	......	.10
.822	.658	.780	.753	S	SW	S	2	4	12	5.7	S. 9 W.	5.	9	10	......	......
.769	.668	.735	.724	E	W	NE	2	2	4	1.3	N. 45 E.	6	9	2	......	.12
.748	.661	.732	.717	......	......	......	....	....	....	5.6	S. 65 W.	6.5	6.6	6.3	......	5.88

Reductions of the monthly meteorological register of the survey of

Date.	Barometer reduced to temperature of 32° Fahr., expressed in United States inches and decimals.				TEMPERATURE—FAHRENHEIT.									VAPOR.			
					Wet bulb, or point of evaporation.			Dry bulb, or temperature of the open air.				Maximum.	Minimum.	Elasticity, in U. S. inches and decimals.			
	7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	Mean.			7 a. m.	2 p. m.	9 p. m.	Mean.
1866.					°	°	°	°	°	°	°	°	°				
Sept. 1	29.666	29.564	29.465	29.565	59	76	68	64	85	72	73.7	85	59	.433	.775	.631	.613
2	29.503	29.434	29.575	29.504	69	75	70	73	82	75	76.7	83	69	.655	.773	.666	.698
3	29.766	29.775	29.736	29.759	58	64	63	62	71	68	67.0	73	58	.429	.503	.509	.480
4	29.753	....	29.588	29.670	61	....	66	65	....	71	68.0	80	61	.483	.....	.572	.528
5	29.538	29.538	29.633	29.570	66	69	59	71	74	66	70.3	74	60	.572	.641	.407	.540
6	29.756	29.758	29.748	29.754	57	65	59	62	73	64	66.3	73	56	.399	.510	.433	.447
7	29.786	29.656	29.426	29.623	54	65	59	59	70	63	64.0	70	53	.351	.550	.447	.449
8	29.416	29.536	29.662	29.538	58	58	56	61	62	61	61.3	63	56	.443	.429	.383	.418
9	29.797	....	29.842	29.869	57	....	52	60	....	55	57.5	63	55	.426	.....	.349	.388
10	29.935	29.839	29.774	29.849	44	62	55	48	69	59	58.7	69	41	.236	.462	.380	.359
11	29.705	29.479	29.281	29.488	52	62	65	56	66	68	66.7	68	49	.335	.502	.577	.471
12	29.258	29.311	29.308	29.292	62	65	64	67	70	68	68.3	70	63	.489	.550	.543	.527
13	29.472	29.601	29.656	29.576	58	59	57	63	65	63	63.7	66	58	.416	.420	.350	.395
14	29.680	29.549	29.550	29.593	51	60	53	55	65	57	59.0	65	50	.321	.451	.350	.374
15	29.872	29.966	30.012	29.950	45	47	49	49	54	55	52.7	56	44	.247	.231	.269	.249
16	30.364	29.912	29.767	29.914	42	52	53	45	56	59	53.3	59	39	.228	.335	.323	.295
17	29.580	29.634	29.672	29.629	57	61	57	61	66	61	62.7	66	55	.412	.470	.412	.431
18	29.677	29.670	29.645	29.664	50	53	52	53	58	56	55.7	60	49	.321	.336	.335	.331
19	29.630	29.627	29.758	29.672	50	50	48	54	54	52	53.3	55	48	.308	.308	.282	.299
20	29.778	29.620	29.523	29.640	46	54	53	49	57	56	54.0	58	44	.271	.378	.363	.337
21	29.436	29.587	29.690	29.571	64	52	47	67	55	52	58.0	67	47	.556	.349	.257	.387
22	29.849	29.914	29.954	29.906	43	49	45	47	55	49	50.3	56	43	.225	.269	.247	.247
23	30.067	30.019	29.997	30.028	38	50	49	41	57	53	50.3	57	37	.190	.268	.295	.251
24	29.987	29.917	29.861	29.922	47	60	53	51	67	59	59.0	67	42	.270	.425	.323	.339
25	29.845	29.671	29.596	29.704	56	64	59	60	70	62	64.0	70	55	.396	.516	.460	.457
26	29.824	29.844	29.825	29.831	49	50	47	53	54	50	52.3	61	46	.295	.308	.283	.295
27	29.859	29.877	29.895	29.877	45	59	54	49	65	58	57.3	6	41	.247	.420	.365	.344
28	30.044	30.022	29.973	30.013	49	61	53	53	66	57	58.7	67	47	.447	.470	.350	.422
29	30.021	29.979	29.925	29.974	46	60	55	49	66	59	58.0	67	45	.363	.438	.380	.394
30	29.885	29.847	24.875	29.869	46	61	58	50	68	63	60.3	68	46	.258	.443	.416	.372
Means....	29.748	29.719	27.704	29.727	....	....	....	56.6	65.0	60.3	60.7	....	....	.371	.447	.398	.404
Oct. 1	29.935	29.905	29.819	29.886	47	60	56	50	67	60	59.0	67	46	.283	.425	.396	.368
2	29.726	29.598	29.548	29.624	58	55	56	63	74	61	66.0	76	55	.416	.181	.383	.327
3	29.745	29.773	29.783	29.767	43	41	41	47	47	45	46.3	60	41	.225	.179	.205	.203
4	29.956	30.015	30.118	30.030	35	41	38	38	46	42	42.0	46	33	.165	.192	.177	.178
5	30.296	....	30.225	30.260	29	....	39	31	....	42	36.5	49	26	.137	....	.199	.168
6	30.200	30.099	30.010	30.103	34	51	46	38	60	49	49.0	60	32	.144	.310	.271	.242
7	29.967	29.860	29.813	29.880	48	62	58	51	68	62	60.3	68	41	.296	.476	.429	.400
8	29.804	29.776	29.779	29.786	57	64	58	61	69	61	63.7	69	57	.412	.529	.443	.465
9	29.835	29.802	29.804	29.814	54	58	56	57	64	60	60.3	65	52	.378	.403	.396	.392
10	29.871	....	29.881	29.876	51	....	55	55	....	59	57.0	62	50	.321	....	.380	.350
11	29.858	29.820	29.792	29.823	47	56	52	50	62	56	56.0	63	46	.283	.369	.335	.329
12	29.805	29.775	29.727	29.769	43	53	54	46	59	58	54.3	60	42	.238	.323	.365	.309
13	29.795	29.787	29.815	29.799	46	51	47	49	57	53	53.0	57	45	.271	.295	.244	.270
14	29.942	29.967	29.977	29.962	45	50	49	48	55	55	52.7	55	42	.260	.295	.269	.275
15	30.082	30.074	30.072	30.076	45	54	51	49	62	55	55.3	62	44	.247	.312	.321	.293
16	30.100	30.015	29.851	29.989	40	56	54	44	64	59	55.7	64	39	.195	.343	.351	.296
17	29.807	29.757	29.747	29.770	50	55	51	55	61	55	57.0	62	50	.295	.354	.321	.323
18	29.844	29.860	29.818	29.841	48	58	54	53	65	58	58.7	65	46	.269	.389	.365	.341
19	29.810	29.791	29.771	29.791	56	64	60	61	73	66	66.7	73	56	.383	.476	.438	.432
20	29.925	29.865	29.823	29.871	56	60	56	60	66	60	62.0	66	56	.396	.438	.396	.410
21	29.772	29.675	29.588	29.678	58	67	61	63	77	70	70.0	77	55	.416	.527	.416	.453
22	29.401	29.418	29.534	29.451	62	57	51	67	64	58	63.0	70	52	.489	.373	.282	.381
23	29.540	29.512	29.513	29.522	47	50	45	52	56	50	52.7	58	45	.257	.282	.234	.258
24	29.563	29.593	29.711	29.622	40	42	38	44	47	42	44.3	50	37	.195	.202	.177	.191
25	29.899	29.956	29.959	29.938	32	35	31	36	40	34	36.7	41	30	.129	.139	.139	.136
26	29.914	29.767	29.690	29.790	32	38	38	36	43	42	40.3	43	28	.129	.164	.177	.157
27	29.674	29.826	29.974	29.825	35	42	36	39	45	40	41.3	47	35	.152	.228	.160	.313
28	30.079	29.938	29.864	29.960	35	40	39	38	44	43	41.7	44	34	.165	.195	.186	.182
29	29.725	29.591	29.473	29.596	47	51	55	50	54	57	53.7	57	38	.283	.335	.407	.342
30	29.313	29.308	29.363	39.328	51	47	41	55	50	48	51.0	58	44	.321	.283	.236	.240
31	29.561	29.658	29.792	29.670	40	40	36	44	45	41	43.3	47	36	.195	.182	.147	.175
Means....	29.830	29.786	29.796	29.809	....	....	....	49.7	58.0	52.9	53.2	....	....	.272	.318	.298	.297

No observations taken in November, the observer being sick.

the northern and northwestern lakes at Sackett's Harbor, New York.

VAPOR.				WIND.								Amount of cloudiness. (0 = clear sky.) (10 = sky entirely overcast.)			Amount of evaporation, in U. S. inches and decimals.	Amount of rain or melted snow, in U. S. inches and decimals.
Humidity. Saturation = 1,000.				Direction. From whence.			Velocity, in miles, per hour.			Resultant velocity, in miles, per hour.	Resultant direction.					
7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.			7 a. m.	2 p. m.	9 p. m.		
											°					
.727	.644	.804	.725	NE...	S......	S......	4	2	4	1.3	S. 38 E.	6	5	6	......	......
.807	.708	.768	.761	S......	S......	W......	25	12	4	12.7	S. 6 W.	9	6	10	......	.50
.772	.663	.743	.726	S.....	W......	E......	2	2	2	0.7	South ..	7	10	8	......	......
.783	......	.754	.769	NE....	....	E......	4	....	2	1.7	N. 57 E.	3	....	8	......	......
.754	.764	.636	.718	S......	SW...	NW...	12	12	25	9.0	S. 84 W.	10	10	1	......	......
.718	.629	.727	.691	S......	SW...	S......	12	12	2	8.0	S. 21 W.	9	2	0	......	......
.703	.751	.776	.743	SE....	NE..	NE....	4	12	25	12.7	N. 52 E	7	10	10	......	......
.825	.772	.713	.770	NW...	NW...	NW...	12	25	12	16.3	N. 45 W.	10	10	6	......	1.14
.822	......	.805	.814	NW...	....	Calm..	4	....	0	1.3	N. 45 W.	10	....	0	......	.06
.704	.653	.761	.706	Calm..	SW...	S......	0	4	2	1.7	S. 31 W.	0	2	0	......	......
.747	.786	.843	.792	NE...	NE....	S......	4	12	25	6.0	N. 41 E	10	10	10	......	......
.740	.751	.793	.761	SW...	SW...	SW...	45	35	35	38.3	S. 45 W.	10	10	8	......	.66
.723	.680	.752	.718	W......	W......	W......	35	45	25	35.0	West...	9	4	4	......	.26
.743	.731	.752	.742	S......	S......	W......	4	25	25	13.0	S. 40 W.	5	10	3	......	......
.710	.552	.620	.627	NW...	NW...	NW...	35	25	4	21.3	N. 45 W.	10	6	4	......	.08
.762	.747	.647	.719	S......	SE....	S......	4	2	25	10.0	S. 3 E.	4	10	10	......	......
.669	.735	.769	.758	S......	SW...	NE....	45	12	4	17.0	S. 6 W.	10	10	10	......	.26
.798	.698	.747	.748	NE....	NW...	NE....	4	2	12	5.3	N. 38 E.	10	10	10	......	.30
.738	.738	.727	.734	NE....	NE....	NE....	25	35	4	21.3	N. 45 E.	10	10	0	......	......
.781	.812	.809	.801	NE....	NE....	NE....	25	25	4	18.0	N. 45 E.	10	10	10	......	.06
.841	.805	.660	.769	SW...	W......	NW...	12	35	12	17.3	West...	10	10	10	......	.66
.698	.620	.710	.676	N.....	W......	SE....	4	2	2	1.0	N. 11 W.	1	3	5	......	.64
.738	.577	.733	.683	NE....	NE....	NE....	4	12	4	6.7	N. 45 E.	0	3	0	......	......
.722	.642	.647	.670	S......	S......	S......	12	25	25	20.7	South ..	0	3	4	......	......
.765	.704	.828	.766	S......	S......	NE....	12	4	4	4.7	S. 11 E.	9	10	8	......	.04
.733	.738	.786	.752	NE....	NE....	Calm..	25	12	0	12.3	N. 45 E.	10	10	2	......	.50
.710	.680	.756	.715	S......	SW...	Calm..	4	12	0	5.0	S. 34 W.	0	2	0	......	.18
.776	.735	.752	.754	S......	SW...	Calm..	4	4	0	2.3	S. 24 W.	2	0	0	......	......
.809	.685	.761	.752	SE....	W......	Calm..	2	4	0	1.0	S. 62 W.	3	4	6	......	......
.716	.647	.723	.695	Calm..	W......	N......	0	4	2	1.7	N. 67 W.	4	6	0	......	......
.754	.702	.743	.735	....	....	....	....	....	....	2.7	S. 61 W.	6.6	7.0	5.1	......	5.34
.786	.642	.765	.731	NE....	W......	Calm..	2	2	0	0.7	N. 17 W.	3	0	0	......	......
.723	.216	.713	.551	S......	S......	S......	12	12	2	8.7	South ..	5	0	10	......	......
.698	.554	.684	.645	NE....	NE....	NE....	35	25	4	21.3	N. 45 E.	10	6	0	......	.16
.719	.617	.661	.666	E......	NE....	NE....	2	25	4	10.0	N. 48 E.	8	10	0	......	......
.788	......	.744	.766	E......	....	S......	2	....	2	1.0	S. 45 E.	0	....	3	......	......
.628	.599	.781	.669	SW...	SW...	Calm..	2	4	0	2.0	S. 45 W.	0	0	0	......	......
.790	.695	.772	.752	S......	S......	S......	12	4	2	6.0	South ..	8	10	0	......	......
.769	.747	.825	.780	S......	SW...	Calm..	2	4	0	1.7	S. 34 W.	4	5	0	......	......
.812	.675	.765	.751	NE....	NE....	NE....	12	12	2	8.7	N. 45 E.	5	8	3	......	......
.743	......	.761	.752	NE....	....	Calm..	2	....	0	0.7	N. 45 E.	5	....	9	......	......
.786	.665	.747	.733	E......	Calm..	Calm..	2	0	0	0.7	East....	7	9	4	......	......
.767	.647	.756	.723	E......	NE....	NE....	4	12	12	9.0	N. 51 E.	6	9	0	......	......
.781	.634	.606	.674	NE....	NE....	NE....	25	25	12	20.7	N. 45 E.	0	0	5	......	......
.777	.681	.620	.693	NE....	NE....	NE....	12	25	4	13.7	N. 45 E.	4	2	0	......	......
.710	.561	.743	.671	NE....	NE....	NE....	4	12	2	6.0	N. 45 E.	0	0	0	......	......
.677	.575	.703	.652	E......	W......	SW...	2	2	12	4.0	S. 45 W.	0	0	0	......	......
.681	.659	.743	.694	W......	SW...	NE....	2	4	4	0.7	West...	0	9	8	......	......
.667	.631	.756	.685	SW...	W......	Calm..	2	4	0	2.0	S. 77 W.	9	0	0	......	......
.713	.582	.635	.645	S......	S......	S......	4	12	4	6.7	South ..	4	3	5	......	......
.765	.635	.765	.722	NE....	NE....	NE....	12	2	2	5.3	N. 45 E.	9	8	5	......	......
.723	.569	.570	.621	S......	S......	S......	4	12	25	13.7	South ..	4	6	3	......	......
.740	.625	.584	.630	S......	W......	SW...	45	60	45	6.7	S. 50 W.	10	4	0	......	......
.660	.627	.646	.644	S......	W......	NW...	4	25	25	15.0	N. 72 W.	0	5	6	......	......
.677	.621	.661	.654	E......	NW...	NE....	4	12	12	6.0	N. 13 E.	10	10	9	......	.34
.610	.557	.712	.626	NE....	NW...	E......	12	4	4	5.0	N. 41 E.	9	6	2	......	.10
.610	.587	.661	.619	SE....	SE....	SW...	4	35	25	15.3	S. 12 E.	10	10	10	......	......
.636	.762	.645	.681	W......	NW...	NE....	25	25	35	15.3	N. 23 W.	8	10	10	......	.22
.719	.677	.669	.688	NE....	NE....	NE....	4	4	4	4.0	N. 45 E.	10	10	10	......	.10
.786	.802	.874	.821	S......	S......	S......	35	35	4	24.7	South ..	10	10	10	......	.06
.743	.786	.704	.744	NW...	W......	W......	4	25	4	10.7	N. 85 W.	10	10	5	......	1.92
.677	.607	.567	.617	NW...	NW...	NW...	12	25	35	24.0	N. 45 W.	9	8	10	......	......
.721	.629	.704	.688	....	....	....	....	....	....	0.3	N. 35 W.	5.9	5.4	4.1	......	2.90

Reductions of the monthly meteorological register of the survey of

Date.	Barometer reduced to temperature of 32° Fahr., expressed in United States inches and decimals.				TEMPERATURE—FAHRENHEIT.										VAPOR.			
					Wet bulb, or point of evaporation.			Dry bulb, or temperature of the open air.							Elasticity, in U. S. inches and decimals.			
	7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	Mean.	Maximum.	Minimum.	7 a. m.	2 p. m.	9 p. m.	Mean.
1866.					°	°	°	°	°	°	°	°	°				
Dec. 1	29. 795	29. 850	29. 868	29. 838	25	26	25	28	28	29	28. 3	29	18	. 100	. 117	. 089	. 102
2	29. 911	29. 905	29. 935	29. 917	26	32	32	30	35	36	33. 7	36	25	. 095	. 142	. 129	. 122
3	29. 941	29. 859	29. 730	29. 843	28	41	38	31	47	44	40. 7	47	26	. 119	. 179	. 151	. 150
4	29. 574	29. 228	29. 386	29. 396	44	49	43	48	54	47	49. 7	54	39	. 236	. 282	. 225	. 248
5	29. 839	29. 913	30. 006	29. 919	40	42	36	44	47	39	43. 3	47	35	. 193	. 202	. 173	. 190
6	30. 049	29. 939	29. 730	29. 906	36	38	38	40	41	41	40. 7	41	34	. 160	. 190	. 190	. 180
7	29. 744	29. 756	29. 699	29. 733	42	44	40	45	48	43	45. 3	48	36	. 228	. 236	. 208	. 224
8	29. 399	29. 122	29. 218	29. 246	45	50	44	49	54	49	50. 7	54	35	. 247	. 308	. 223	. 259
9	29. 434	29. 447	29. 370	29. 417	35	33	30	38	36	34	36. 0	44	29	. 165	. 149	. 121	. 145
10	29. 451	29. 529	29. 581	29. 520	24	22	24	27	25	26	26. 0	34	18	. 095	. 084	. 106	. 095
11	29. 677	29. 674	29. 647	29. 666	19	22	23	22	25	27	24. 7	27	16	. 069	. 084	. 078	. 077
12	29. 697	29. 721	29. 734	29. 717	21	22	24	25	25	27	25. 7	27	19	. 067	. 084	. 095	. 082
13	29. 844	29. 816	29. 829	29. 830	21	23	15	24	27	18	23. 0	27	13	. 079	. 078	. 095	. 084
14	30. 048	30. 123	30. 154	30. 108	5	9	4	8	12	6	08. 7	17	− 0	. 021	. 031	. 030	. 027
15	30. 217	30. 196	30. 122	30. 178	0	8	4	2	11	7	06. 7	11	− 8	. 021	. 028	. 018	. 022
16	29. 886	29. 693	29. 453	29. 677	6	14	16	8	18	19	15. 0	19	− 0	. 034	. 037	. 056	. 042
17	29. 313	29. 442	29. 625	29. 460	18	19	20	22	23	23	22. 7	23	13	. 053	. 058	. 074	. 062
18	29. 935	29. 964	29. 841	29. 913	18	23	25	22	28	30	26. 7	30	15	. 053	. 066	. 078	. 066
19	29. 709	29. 725	29. 821	29. 752	26	32	17	31	37	21	29. 7	37	15	. 083	. 116	. 049	. 083
20	30. 270	30. 350	30. 446	30. 355	− 5	− 3	−16	− 3	− 1	−13	05. 7	12	−19	. 012	. 015	....	. 014
21	30. 433	30. 128	30. 125	30. 229	−22	1	− 2	−20	4	− 1	05. 7	7	−30	....	. 012	. 028	. 020
22	29. 973	29. 778	29. 643	29. 798	22	32	33	27	37	39	34. 3	40	− 5	. 061	. 116	. 110	. 096
23	29. 378	29. 300	29. 005	29. 228	37	39	42	43	44	46	47. 3	46	35	. 142	. 173	. 215	. 177
24	29. 147	29. 205	29. 262	29. 205	38	38	34	42	42	38	40. 7	46	34	. 177	. 177	. 144	. 166
25	29. 410	29. 480	29. 578	29. 489	32	32	28	35	34	30	33. 0	36	25	. 142	. 155	. 130	. 142
26	29. 683	29. 668	29. 496	29. 612	27	28	29	30	31	31	30. 7	31	23	. 113	. 119	. 137	. 123
27	29. 263	29. 128	29. 136	29. 176	30	31	22	32	34	25	30. 3	34	21	. 144	. 139	. 084	. 122
28	29. 152	29. 212	29. 317	29. 227	13	15	12	17	17	15	16. 3	23	11	. 033	. 063	. 041	. 046
29	29. 626	29. 711	29. 682	29. 673	6	10	14	8	13	18	13. 0	21	− 0	. 034	. 034	. 037	. 035
30	29. 923	30. 000	30. 036	29. 986	10	13	15	14	17	18	16. 3	18	7	. 023	. 033	. 052	. 036
31	30. 001	29. 910	29. 877	29. 929	12	19	21	14	23	24	20. 3	24	9	. 052	. 058	. 079	. 063
Means....	29. 733	29. 702	29. 689	29. 708	....	....	....	25. 3	29. 6	26. 9	27. 3	....	....	. 099	. 115	. 105	. 106

the northern and northwestern lakes at Sackett's Harbor, New York.

VAPOR.				WIND.								Amount of cloudiness. (0=clear sky.) (10=sky entirely overcast.)			Amount of evaporation, in U. S. inches and decimals.	Amount of rain or melted snow, in U. S. inches and decimals.
Humidity. Saturation=1,000.				Direction. From whence.			Velocity, in miles, per per hour.			Resultant velocity, in miles, per hour.	Resultant direction.					
7 a. m.	2 p. m.	9 p. m.	Mean.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.		°	7 a. m.	2 p. m.	9 p. m.		
.655	.768	.556	.660	W	W	W	12	12	4	9.3	West	6	3	8	......	......
.569	.698	.610	.626	E	S	SW	2	4	4	2.3	S. 7 W.	10	10	1	......	.02
.685	.554	.522	.587	S	S	S	2	4	12	6.0	South	1	0	4	......	......
.704	.674	.698	.692	S	S	S	12	45	45	34.0	South	10	10	10	......	......
.677	.624	.726	.676	W	SW	S	12	25	2	11.7	S. 57 W.	9	8	0	......	.16
.645	.738	.738	.707	S	E	E	2	4	12	5.7	S. 83 E.	10	10	10	......	......
.762	.704	.750	.739	W	SW	S	12	12	2	7.7	S. 63 W.	10	10	0	......	.12
.710	.738	.638	.695	SE	S	SW	4	45	35	25.3	S. 17 W.	9	10	10	......	......
.719	.705	.617	.680	SW	SW	SW	45	25	35	35.0	S. 45 W.	9	8	6	......	.64
.644	.622	.754	.673	W	W	W	45	45	25	38.3	West	10	10	0	......	.08
.584	.622	.529	.578	S	S	S	25	35	25	28.3	South	9	10	10	......	.08
.500	.622	.644	.589	W	W	N.	25	12	4	12.7	N. 84 W.	10	10	4	......	.06
.610	.529	.644	.594	NW	S	NE	4	2	4	1.2	North	9	7	3	......	.08
.334	.418	.520	.424	NE	N.	Calm	4	2	0	1.7	N. 29 E.	10	9	0	......	......
.438	.398	.308	.381	Calm	E	E	0	2	4	2.0	East	9	10	8	......	......
.553	.371	.541	.488	NE	NE	NE	12	12	25	16.3	N. 45 E.	10	10	10	......	......
.449	.407	.598	.505	NE	N.	Calm	25	4	0	9.3	N. 39 E.	10	9	8	......	.22
.449	.433	.465	.449	NW	Calm	S	2	0	4	1.0	S. 39 W.	10	4	10	......	......
.480	.527	.431	.479	S	W	NE	12	12	35	6.0	N. 45 E.	10	10	10	......	......
.317	.369	......	.343	N.	N.	Calm	35	12	0	15.7	North	0	0	0	......	.12
......	.223	.683	.453	Calm	Calm	S	0	0	2	0.7	South	0	5	3	......	......
.415	.527	.463	.468	S	S	S	25	25	35	28.3	South	10	10	10	......	......
.511	.597	.691	.600	S	S	S	12	12	4	9.3	South	10	10	10	......	......
.661	.661	.628	.647	SW	SW	SW	25	4	25	18.0	S. 45 W.	10	10	10	......	.52
.698	.792	.782	.757	SW	W	NW	4	25	25	12.3	N. 81 W.	10	10	10	......	.10
.675	.685	.788	.716	W	S	S	25	4	2	8.7	S. 76 W.	10	8	10	......	.12
.794	.712	.622	.709	S	NE	NW	4	4	35	10.7	N. 43 W.	10	10	10	......	......
.350	.671	.475	.499	NW	NW	NW	45	45	35	41.7	N. 45 W.	10	10	10	......	.06
.553	.438	.371	.454	NW	NW	NW	12	12	2	8.7	N. 45 W.	9	8	5	......	.08
.820	.350	.525	.565	N	SE	SE	2	2	4	1.7	S. 64 E.	10	10	10	......	......
.635	.467	.610	.571	S	E	Calm	2	2	0	1.0	S. 45 E.	8	10	10	......	......
.590	.573	.597	.581	....	....	....	....	....	....	5.9	S. 58 W.	8.6	8.3	6.4	......	2.4

SUPERIOR CITY, WISCONSIN.—ALTITUDE 640 FEET.

TABLE B.—Maximum, minimum, and mean barometrical pressure for each month from the year 1859 to 1866 inclusive, reduced to 32° Fahr. + 28 inches.

Year.	January.			February.			March.			April.			May.			June.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1859																		
1860	1.994	0.547	1.273	1.708	0.620	1.289	1.736	0.567	1.241	1.793	0.400	1.222	1.486	0.525	1.163	1.597	0.710	1.244
1861	1.884	0.773	1.336	1.668	0.513	1.192	1.940	0.650	1.295	1.586	0.657	1.182	1.762	0.259	1.237	1.535	0.903	1.262
1862	1.834	0.972	1.418	1.717	0.748	1.351	1.630	0.723	1.283	1.738	0.831	1.376	1.698	0.994	1.331	1.671	0.910	1.336
1863	1.710	0.592	1.266	1.916	0.547	1.423	1.781	0.825	1.335	1.769	0.618	1.351	1.638	0.858	1.301	1.753	0.988	1.304
1864	1.794	0.634	1.279	1.802	0.793	1.205	1.720	0.709	1.225	1.705	1.114	1.362	1.503	0.728	1.244	1.600	0.864	1.331
1865	1.689	0.952	1.350	1.869	0.787	1.386	1.709	0.695	1.280	1.878	0.245	1.269	1.523	0.741	1.261	1.537	0.841	1.239
1866	2.371	1.012	1.479	1.845	0.640	1.396	2.018	0.706	1.464	1.750	0.614	1.251	1.624	0.751	1.261	1.653	0.685	1.172

Year.	July.			August.			September.			October.			November.			December.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1859				1.613	0.991	1.291	1.742	0.753	1.314	1.725	0.780	1.356	1.852	0.525	1.307	2.003	0.825	1.396
1860	1.680	0.692	1.240	1.528	0.958	1.276	1.816	0.680	1.343	1.852	0.859	1.359	1.684	0.463	1.255	1.832	0.820	1.408
1861	1.578	0.965	1.247	1.600	1.075	1.363	1.839	0.718	1.333	1.640	0.632	1.223	1.730	0.613	1.220	1.983	0.880	1.398
1862	1.555	0.867	1.231	1.614	0.855	1.291	1.734	0.873	1.299	2.026	0.671	1.270	2.004	0.829	1.388	2.019	0.740	1.312
1863	1.634	1.043	1.315	1.542	0.930	1.298	1.773	0.961	1.335	1.973	0.388	1.340	1.911	0.654	1.274	1.894	0.755	1.424
1864	1.765	1.120	1.317	1.622	0.810	1.266	1.512	0.776	1.261	1.739	0.822	1.280	1.759	0.529	1.243	1.856	0.541	1.244
1865	1.703	0.928	1.352	1.599	0.973	1.345	1.711	0.878	1.273	1.745	0.857	1.388	1.880	0.572	1.279	1.888	0.393	1.281
1866	1.754	0.914	1.254	1.650	0.891	1.332	1.637	0.881	1.298	1.817	0.692	1.318	2.001	0.770	1.294	1.811	0.605	1.313

SUPERIOR CITY, WISCONSIN. + 28 INCHES.

TABLE B.—Maximum, minimum, and mean barometrical pressure reduced to 32° Fahr., for seasons.

Year.	Spring.			Summer.			Autumn.			Winter.			Year.			Range.
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	
1859	......	......	......	......	......	......	1.852	0.525	1.325	......	......	......	(1.852)	(0.525)	......	(1.327)
1860	1.793	0.400	1.208	1.680	0.692	1.253	1.852	0.463	1.319	2.003	0.547	1.319	1.944	0.400	1.276	1.544
1861	1.940	0.259	1.238	1.600	0.903	1.291	1.839	0.613	1.259	1.884	0.513	1.312	1.983	0.259	1.274	1.724
1862	1.738	0.723	1.330	1.671	0.855	1.286	2.026	0.671	1.319	1.983	0.748	1.389	2.026	0.671	1.324	1.355
1863	1.781	0.618	1.329	1.753	0.930	1.305	1.973	0.388	1.316	2.019	0.547	1.334	1.973	0.388	1.322	1.585
1864	1.720	0.709	1.377	1.765	0.810	1.305	1.759	0.529	1.261	1.824	0.634	1.303	1.856	0.541	1.288	1.315
1865	1.878	0.245	1.270	1.703	0.878	1.312	1.880	0.572	1.313	1.869	0.541	1.327	1.880	0.393	1.308	1.487
1866	2.018	0.614	1.325	1.754	0.685	1.253	2.001	0.692	1.303	2.371	0.393	1.385	2.371	0.605	1.318	1.766

SUPERIOR CITY, WISCONSIN.

TABLE B.—Maximum, minimum, and mean temperature for each month from the year 1859 to 1866 inclusive.

Year.	January.			February.			March.			April.			May.			June.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1859	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
1860	49	—32	12.6	49	—21	15.3	69	11	34.2	68	17	37.7	71	18	47.9	76	46	57.5
1861	32	—21	13.3	46	—33	17.2	50	—15	29.9	61	18	36.6	78	23	43.4	82	31	53.7
1862	32	—31	9.2	36	—30	7.0	43	—11	22.9	61	3	34.0	82	25	46.9	89	38	54.9
1863	45	—17	18.9	47	—38	13.6	50	—10	23.4	67	15	38.6	90	24	51.4	94	29	57.6
1864	53	—37	13.7	55	—33	19.6	59	—17	23.3	58	18	36.0	92	24	48.7	96	32	57.9
1865	42	—26	11.2	42	—12	19.5	61	—21	21.6	70	—5	35.0	92	23	47.8	90	37	54.4
1866	45	—23	10.5	47	—31	9.1	50	—13	17.3	62	10	36.0	83	20	46.3	92	32	57.6

SUPERIOR CITY, WISCONSIN.

TABLE B.—Maximum, minimum, and mean temperature for each month from the year 1859 to 1866 inclusive.

Year.	July.			August.			September.			October.			November.			December.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1859	....	....	....	81	43	63.7	71	21	52.9	81	21	41.4	45	10	29.6	29	—31	4.2
1860	88	44	65.3	83	47	60.6	78	32	52.3	69	23	43.6	50	—11	28.0	38	—19	14.8
1861	87	35	60.2	86	39	61.8	82	25	55.8	75	21	43.9	55	—15	30.1	41	—14	19.7
1862	90	45	64.5	89	45	64.7	83	35	55.5	68	18	43.1	54	—3	27.4	45	—18	21.1
1863	84	36	62.0	87	33	61.7	86	24	53.0	72	16	38.6	59	—13	28.7	47	—28	20.0
1864	94	43	64.2	97	42	68.3	84	27	52.4	65	22	43.2	60	—10	28.8	40	—22	10.5
1865	88	40	61.8	92	42	64.0	88	40	61.8	65	-18	44.7	66	16	38.3	38	—28	11.1
1866	99	43	67.6	84	39	61.2	75	23	52.8	84	15	44.8	58	0	31.4	49	—20	14.6

SUPERIOR CITY, WISCONSIN.

TABLE B.—Maximum, minimum, and mean temperature for seasons and years from 1859 to 1866 inclusive.

Year.	Spring.			Summer.			Autumn.			Winter.			Year.			Range.
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	
1859	....	....	....	....	....	....	81	10	41.3	....	....	....	....	....	....	....
1860	71	11	39.9	88	44	60.1	78	—11	41.3	49	—32	10.7	88	—32	39.2	120
1861	78	—15	34.0	87	31	58.6	82	—15	43.3	46	—33	15.1	87	—33	38.1	120
1862	82	—11	34.6	90	38	61.4	83	—3	42.0	41	—31	12.0	90	—31	37.6	121
1863	90	—10	37.8	94	29	60.4	86	—13	40.1	47	—38	17.9	94	—38	39.0	132
1864	92	—17	36.0	97	32	63.5	84	—10	41.5	55	—37	17.8	97	—37	38.8	134
1865	92	—21	34.8	92	37	60.1	88	16	48.3	42	—26	13.7	92	—28	39.3	120
1866	83	—13	33.2	99	32	62.1	84	0	43.0	47	—31	10.2	99	—31	37.4	130

SUPERIOR CITY, WISCONSIN.

TABLE B.—Amount of rain and melted snow for months, seasons, and years, in United States inches and decimals.

Year.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Spring.	Summer.	Autumn.	Winter.	Year.
1859								0.96	2.24	1.42	2.05	0.38			5.71		
1860	1.35	1.90	1.19	1.19	5.57	1.14	2.06	5.52	2.74	3.47	0.50	0.42	7.95	8.72	6.71	3.63	27.05
1861	1.40	4.24	1.33	3.83	4.57	3.59	2.54	3.09	5.18	3.74	2.35	0.49	9.73	9.22	11.27	6.06	36.35
1862	1.29	0.87	1.67	1.93	0.98	2.26	2.47	2.56	5.13	2.08	0.46	0.80	4.58	7.56	7.67	2.65	22.77
1863	0.63	0.83	0.43	0.42	2.27	0.42	1.86	4.84	1.36	2.73	0.14	1.37	3.12	7.12	4.23	2.26	17.30
1864	0.46	0.78	2.01	0.72	1.24	1.46	3.64	3.58	2.49	1.91	1.84	0.84	3.97	8.68	6.24	2.61	20.97
1865	0.34	2.30	1.24	3.31	2.31	4.57	4.06	3.07	6.22	0.82	0.59	1.23	6.86	11.70	7.63	3.48	30.06
1866	0.93	0.18	2.23	2.78	1.23	2.96	4.47	1.31	4.08	2.45	2.52	0.60	8.24	8.74	9.05	2.34	25.74

ONTONAGON, MICHIGAN.—ALTITUDE 610 FEET.

TABLE B.—Maximum, minimum, and mean barometrical pressure for each month from the year 1859 to 1865 inclusive, reduced to 32° Fahr. + 28 inches.

Year.	January.			February.			March.			April.			May.			June.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1859																		
1860	1.893	0.579	1.303	1.761	0.444	1.299	1.757	0.591	1.328	1.859	0.492	1.321	1.514	0.627	1.209	1.680	0.412	1.282
1861	1.854	0.715	1.318	1.730	0.527	1.224	1.929	0.502	1.325	1.655	0.739	1.235	1.897	0.214	1.263	1.602	0.726	1.268
1862	1.819	1.030	1.378	1.699	0.747	1.352	1.632	0.602	1.271	1.733	0.997	1.398	1.722	1.035	1.331	1.627	0.949	1.337
1863	1.787	0.742	1.213	1.946	0.567	1.438	1.878	0.824	1.363	1.775	0.692	1.358	1.593	0.816	1.316	1.752	0.742	1.309
1864	1.775	0.582	1.245	1.719	0.652	1.161	1.668	0.711	1.192	1.690	1.078	1.344	1.610	0.728	1.233	1.789	0.841	1.380
1865	1.710	0.359	1.252	1.794	0.817	1.375	1.677	0.639	1.238	1.807	0.311	1.261	1.506	0.688	1.249	1.534	0.825	1.218

ANTONAGON, MICHIGAN.—ALTITUDE 610 FEET

TABLE B.—Maximum, minimum, and mean barometrical pressure for each month from the year 1859 to 1865 inclusive, reduced to 32° Fahr. + 28 inches.

Year.	July.			August.			September.			October.			November.			December.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1859	....	....	....	1.785	1.030	1.308	1.760	0.812	1.356	1.775	0.967	1.367	1.991	0.685	1.407	1.708	0.856	1.339
1860	1.689	0.648	1.257	1.582	0.927	1.298	1.840	0.747	1.363	1.827	0.845	1.365	1.663	0.385	1.218	1.923	0.781	1.383
1861	1.576	1.013	1.273	1.635	1.059	1.367	1.804	0.667	1.320	1.666	0.633	1.221	1.753	0.542	1.207	1.862	0.745	1.370
1862	1.542	0.884	1.237	1.601	0.892	1.307	1.766	0.832	1.329	1.963	0.708	1.276	2.043	0.888	1.389	2.017	0.790	1.279
1863	1.634	1.024	1.316	1.569	0.987	1.315	1.794	0.977	1.370	1.937	0.442	1.346	1.871	0.673	1.262	1.857	0.605	1.401
1864	1.747	1.032	1.355	1.575	0.772	1.275	1.579	0.767	1.275	1.694	0.314	1.227	1.764	0.567	1.220	1.790	0.452	1.124

ONTONAGON, MICHIGAN. + 28 INCHES.

TABLE B.—Maximum, minimum, and mean barometrical pressure reduced to 32° Fahr., for seasons.

Year.	Spring.			Summer.			Autumn.			Winter.			Year			Range.
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	
1859	....	....	....	....	....	....	1.991	0.685	1.376	....	....	....	1.991	0.685	....	1.306
1860	1.859	0.492	1.286	1.689	0.412	1.279	1.840	0.385	1.315	1.893	0.444	1.314	1.923	0.385	1.302	1.538
1861	1.929	0.214	1.274	1.635	0.726	1.302	1.804	0.542	1.249	1.923	0.527	1.308	1.929	0.214	1.282	1.715
1862	1.733	0.602	1.333	1.627	0.884	1.244	2.043	0.708	1.331	1.862	0.745	1.367	2.043	0.602	1.323	1.441
1863	1.878	0.692	1.346	1.752	0.742	1.313	1.937	0.442	1.326	2.017	0.567	1.310	1.946	0.442	1.332	1.504
1864	1.690	0.711	1.256	1.789	0.772	1.337	1.764	0.314	1.241	1.857	0.582	1.269	1.790	0.314	1.252	1.476
1865	....	....	....	....	....	....	....	....	....	1.794	0.359	1.250	....	....	....	....

ONTONAGON, MICHIGAN.—ALTITUDE 610 FEET.

TABLE B.—Maximum, minimum, and mean temperature for each month from the year 1859 to 1865 inclusive.

Year.	January.			February.			March.			April.			May.			June.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1859	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
1860	45	—21	15.7	39	—15	14.2	61	6	30.5	72	21	37.8	86	27	53.0	87	45	60.1
1861	33	—14	16.8	45	—37	18.1	49	— 9	22.1	62	11	38.5	74	19	46.0	95	33	59.4
1862	33	—25	12.8	31	—23	8.4	42	—15	23.2	59	— 5	34.7	80	26	46.5	88	30	55.3
1863	42	— 8	22.9	45	— 8	17.6	47	— 6	22.5	70	8	41.5	94	20	51.6	95	30	57.4
1864	43	—34	14.8	41	—16	19.9	50	—13	22.0	57	12	35.8	82	19	49.5	97	30	65.5
1865	34	—31	15.3	48	—21	20.5	59	—22	21.9	75	7	35.8	86	22	48.8	95	38	57.9

Year.	July.			August.			September.			October.			November.			December.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1859	......	......	......	86	......	86.6	65	......	57.5	69	......	44.5	50	......	31.9	34	—20	12.7
1860	86	49	63.7	89	42	61.7	85	20	52.7	63	24	44.1	54	—3	31.2	38	—16	19.3
1861	87	37	63.2	95	33	63.3	89.5	33	57.0	76	22	45.6	47	—1	31.8	47	— 7	24.4
1862	94	43	64.7	86	41	63.4	88	29	56.0	74	19	44.6	49	2	29.6	49	—13	24.2
1863	83	34	61.4	94	35	61.9	89	20	51.8	63	16	39.5	55	—3	31.2	44	— 3	23.4
1864	97	45	67.0	98	44	68.5	84	31	54.2	82	28	43.0	50	—3	31.2	47	—15	15.7

ONTONAGON, MICHIGAN. + 28 INCHES.

TABLE B.—Maximum, minimum, and mean temperature for seasons and years from 1859 to 1865 inclusive.

Year.	Spring.			Summer.			Autumn.			Winter.			Year.			Range.
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	
1859							69		44.6							
1860	86	6	40.4	89	42	61.8	85	—3	42.7	45	—21	14.2	89	—21	40.3	110
1861	74	— 9	35.5	95	33	62.0	89.5	—1	44.8	45	—37	18.1	95	—37	40.5	132
1862	80	—15	34.8	94	30	61.1	88	2	43.4	47	—25	15.2	94	—25	38.6	119
1863	94	— 6	38.5	95	30	60.4	89	—3	40.8	49	—13	21.6	95	— 8	40.3	103
1864	82	—13	35.8	98	30	67.0	84	—3	42.8	44	—34	19.4	98	—34	40.6	132
1865										48	—31	17.2				

ONTONAGON, MICHIGAN.—ALTITUDE 610 FEET.

TABLE B.—Amount of rain and melted snow for months, seasons, and years, in United States inches and decimals.

Year.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Spring.	Summer.	Autumn.	Winter.	Year.
1859								2.36	2.03	1.15	1.50	2.46			4.68		
1860	2.12	1.16	0.74	0.98	2.04	1.14	1.36	2.38	1.75	3.26	1.32	1.84	3.76	4.88	6.33	5.74	20.09
1861	3.14	1.25	2.18	4.17	2.33	5.02	2.92	1.16	3.18	2.54	2.31	2.86	8.68	9.10	8.03	6.23	33.06
1862	4.02	1.35	2.37	2.46	1.51	0.42	0.91	4.79	3.40	2.07	0.48	3.25	6.34	6.12	5.95	8.23	27.03
1863	2.43	2.92	0.72	0.65	1.69	1.81	2.35	4.01	2.72	2.30	0.87	0.92	3.06	8.17	5.89	8.60	23.39
1864	1.54	1.52	0.35	0.17	2.74	0.63	3.65	1.88	1.83	1.57	3.22	2.98	3.26	6.16	6.62	3.98	22.08
1865	1.62	0.55	2.08	2.63	2.66	3.15										5.15	

MARQUETTE, MICHIGAN.—ALTITUDE 634 FEET.

TABLE B.—Maximum, minimum, and mean barometrical pressure for each month from the year 1859 to 1866, inclusive, reduced to 32° Fahr. + 28 inches.

Year.	January.			February.			March.			April.			May.			June.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1859																		
1860	1.782	0.552	1.216	1.678	0.444	1.262	1.715	0.552	1.224	1.848	0.507	1.280	1.580	0.721	1.216	1.591	0.787	1.270
1861	1.861	0.713	1.282	1.648	0.542	1.195	1.957	0.495	1.315	1.754	0.713	1.230	1.750	0.284	1.246	1.528	0.745	1.261
1862	1.912	0.875	1.307	1.670	0.639	1.283	1.637	0.535	1.229	1.689	0.658	1.347	1.683	0.955	1.296	1.620	0.863	1.297
1863	1.708	0.698	1.243	1.921	0.646	1.424	1.807	0.732	1.347	1.757	0.721	1.366	1.534	0.744	1.292	1.734	0.619	1.276
1864	1.698	0.548	1.165	1.635	0.516	1.074	1.560	0.503	1.153	1.628	1.000	1.289	1.410	0.665	1.171	1.571	0.795	1.258
1865	1.612	0.797	1.210	1.780	0.944	1.330	1.601	0.563	1.171	1.674	0.382	1.200	1.530	0.673	1.195	1.487	0.748	1.194
1866	2.421	0.730	1.354	1.853	0.612	1.282	1.857	0.591	1.388	1.596	0.594	1.231	1.566	0.774	1.205	1.614	0.722	1.135

Year.	July.			August.			September.			October.			November.			December.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1859	1.676	0.784	1.350	1.606	1.055	1.393	1.726	0.766	1.335	1.668	0.587	1.332	1.885	0.480	1.314	1.687	0.825	1.332
1860	1.622	0.700	1.252	1.602	0.956	1.284	1.842	0.703	1.347	1.833	0.698	1.357	1.659	0.355	1.192	1.953	0.753	1.354
1861	1.625	1.004	1.259	1.663	1.022	1.359	1.861	0.772	1.309	1.685	0.641	1.223	1.665	0.405	1.181	1.881	0.663	1.351
1862	1.487	0.867	1.200	1.573	0.900	1.276	1.737	0.941	1.314	1.850	0.672	1.255	2.157	0.842	1.380	1.975	0.820	1.284
1863	1.647	0.980	1.308	1.574	0.804	1.270	1.744	0.884	1.340	1.852	0.500	1.329	1.777	0.708	1.226	1.782	0.527	1.334
1864	1.587	0.966	1.240	1.480	0.758	1.211	1.493	0.739	1.196	1.560	0.675	1.167	1.656	0.582	1.132	1.740	0.312	1.097
1865	1.595	0.862	1.315	1.592	0.964	1.339	1.642	0.910	1.291	1.475	0.621	1.342	1.932	0.433	1.250	1.660	0.391	1.194
1866	1.475	0.872	1.215	1.656	0.935	1.276	1.594	0.704	1.246	1.810	0.434	1.282	2.002	0.812	1.263	1.890	0.692	1.236

MARQUETTE, MICHIGAN. + 28 INCHES.

TABLE B.—Maximum, minimum, and mean barometrical pressure reduced to 32° Fahr., for seasons.

Year.	Spring.			Summer.			Autumn.			Winter.			Year.			Range.
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	
1859							1.885	0.480	1.327							
1860	1.848	0.507	1.240	1.622	0.700	1.268	1.842	0.355	1.298	1.782	0.444	1.270	1.953	0.355	1.271	1.598
1861	1.957	0.284	1.263	1.663	0.745	1.293	1.861	0.405	1.238	1.953	0.542	1.277	1.957	0.284	1.268	1.673
1862	1.689	0.535	1.291	1.620	0.863	1.258	2.157	0.672	1.316	1.912	0.639	1.314	2.157	0.535	1.289	1.622
1863	1.807	0.721	1.335	1.734	0.619	1.285	1.852	0.500	1.298	1.975	0.646	1.317	1.921	0.500	1.313	1.421
1864	1.628	0.503	1.204	1.587	0.758	1.236	1.656	0.582	1.165	1.782	0.516	1.191	1.740	0.312	1.179	1.428
1865	1.674	0 382	1.189	1.595	0.748	1.283	1.932	0.433	1.294	1.780	0.312	1.212	1.932	0.382	1.252	1.650
1866	1.857	0.591	1.275	1.656	0.722	1.209	2.002	0.434	1.264	2.421	0.391	1.277	2.421	0.434	1.259	1.987

MARQUETTE, MICHIGAN.—ALTITUDE 634 FEET.

TABLE B.—Maximum, minimum, and mean temperature for each month from the year 1859 to 1866, inclusive.

Year.	January.			February.			March.			April.			May.			June.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1859																		
1860	51	—14	18.8	46	—13	17.2	62	15	33.1	68	15	37.5	86	32	53.0	95	45	60.1
1861	35	—18	17.8	53	—33	19.8	47	—19	21.8	58	14	38.0	85	16	46.0	92	31	59.9
1862	37	—18	15.0	39	—11	11.1	46	0	25.1	60	3	36.0	90	24	50.0	83	31	56.6
1863	45	—25	25.6	44	—23	20.2	47	— 1	25.0	73	10	41.5	93	28	53.5	95	35	59.3
1864	47	—31	17.5	47	—22	22.1	59	—11	25.4	66	17	37.4	88	25	51.1	101	35	64.7
1865	45	— 7	17.2	48	0	24.7	63	—17	26.2	72	8	38.5	84	24	57.6	95.5	38	61.4
1866	40	—15	16.2	42	—25.5	12.2	48.5	—11	18.2	74	9	39.2	86.5	27	47.1	100.5	30	61.5

MARQUETTE, MICHIGAN.—ALTITUDE 634 FEET.

TABLE B.—Maximum, minimum, and mean temperature for each month from the year 1859 to 1866, inclusive.

Year.	July.			August.			September.			October.			November.			December.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1859	93	40	65.0	97	43	63.7	74	35	54.1	85	25	41.1	53	15	32.8	39	—19	14.6
1860	93	41	62.8	90	38	61.4	81	23	52.8	69	25	45.2	62	—2	31.0	36	—5	19.8
1861	90	38	63.2	97	38	63.6	87	32	56.2	72	24	46.4	48	2	33.0	51	—7	26.6
1862	103	33	65.6	89	39	64.2	92	31	56.9	70	15	44.6	66	10	30.1	46	1	26.0
1863	88	37	61.2	91	38	62.8	93	24	54.3	76	19	41.2	......	......	31.7	47	3	25.3
1864	101	43	69.9	100	45	71.3	80	33	56.4	65	29	44.6	57	2	33.4	45	16	19.9
1865	91.5	38	62.1	94	43.5	66.9	92	40	66.7	84	25	43.7	69	20	39.9	40	—5	20.1
1866	99.5	43	71.6	84.5	43	60.7	82	32.5	55.3	85	22.5	49.6	57.5	22	35.2	60.5	—5	22.3

MARQUETTE, MICHIGAN.

TABLE B.—Maximum, minimum, and mean temperature for seasons and years from 1859 to 1866, inclusive.

Year.	Spring.			Summer.			Autumn.			Winter.			Year.			Range.
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	
1859	......	......	......	......	......	......	85	15	42.7	......	......	......	......	......	......	......
1860	86	15	41.2	95	38	61.4	81	—2	43.0	51	—19	16.9	95	—14	41.0	109
1861	85	—19	35.3	97	31	62.2	87	2	45.2	53	—33	19.1	97	—33	41.0	130
1862	90	0	37.0	103	31	62.1	92	10	43.8	51	—18	17.6	103	—18	40.1	121
1863	93	—1	39.9	95	35	61.2	93	19	42.4	46	—25	23.9	95	—25	41.8	120
1864	88	—11	38.0	101	35	68.3	80	2	44.8	47	—31	21.3	101	—31	42.7	132
1865	84	—17	38.8	95.5	38	63.5	92	20	50.1	48	—7	20.6	95.5	—17	43.3	112.5
1866	86.5	—11	34.8	100.5	30	64.6	85	22	46.7	42	—25.5	16.2	100.5	—25.5	40.8	126

MARQUETTE, MICHIGAN.—ALTITUDE 634 FEET.

TABLE B.—Amount of rain and melted snow for months, seasons, and years in United States inches and decimals.

Year.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Spring.	Summer.	Autumn.	Winter.	Year.
1859	......	......	......	......	......	......	3.26	3.45	3.54	1.42	3.73	2.24	......	......	8.96	......	......
1860	1.41	2.90	2.00	2.54	2.26	2.89	0.82	2.13	1.05	2.50	2.35	2.94	6.80	5.84	5.90	6.55	25.79
1861	4.16	4.57	1.15	2.65	3.52	7.11	2.47	1.52	5.42	2.10	3.35	0.96	7.32	11.10	10.87	11.67	38.98
1862	2.03	0.96	1.78	3.32	2.71	1.24	2.75	3.93	4.32	3.07	2.10	2.03	8.01	7.92	9.49	3.95	36.35
1863	1.96	1.65	1.93	—	1.21	2.60	4.24	7.34	2.66	4.39	2.04	3.06	(3.14)	14.18	9.09	5.64	(33.08)
1864	1.79	1.87	1.14	1.39	0.55	0.31	1.95	1.73	2.29	2.17	4.24	2.89	3.08	3.99	8.70	6.72	22.32
1865	1.00	2.07	3.99	3.93	2.25	3.98	3.26	1.11	1.01	1.84	0.59	1.05	10.17	8.35	3.44	5.97	26.08
1866	2.37	1.21	1.97	1.75	0.78	4.36	3.59	2.95	2.15	3.99	2.60	1.77	4.50	10.90	8.74	4.63	29.49

THUNDER BAY ISLAND, MICHIGAN.—ALTITUDE 614 FEET.

TABLE B.—Maximum, minimum, and mean barometrical pressure for each month from the year 1859 to 1865 inclusive, reduced to 32° Fahr. + 28 inches.

Year.	January.			February.			March.			April.			May.			June.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1859	1.864	0.907	1.388	1.751	0.578	1.337	1.879	0.050	1.130	1.776	0.558	1.295	1.842	0.867	1.393	1.824	0.991	1.367
1860	1.874	0.683	1.306	1.790	0.551	1.327	1.683	0.644	1.262	1.984	0.481	1.309	1.715	0.876	1.288	1.643	0.732	1.299
1861	1.979	0.757	1.355	1.746	0.573	1.245	1.887	0.583	1.348	1.830	0.827	1.287	1.693	0.530	1.293	1.581	0.875	1.319
1862	1.885	0.884	1.442	1.806	0.765	1.372	1.632	0.700	1.291	1.916	0.756	1.435	1.700	0.928	1.336	1.735	0.879	1.350
1863	1.893	0.563	1.319	1.992	0.800	1.472	1.856	0.850	1.375	1.707	0.534	1.404	1.620	0.761	1.332	1.661	0.677	1.315
1864	1.825	0.734	1.306	1.823	0.641	1.199	1.765	0.493	1.252	1.763	0.981	1.363	1.544	0.956	1.269	1.799	0.786	1.430
1865	1.838	1.039	1.350	1.881	0.992	1.455	1.777	0.423	1.292	1.880	0.485	1.366	1.727	0.817	1.349	1.608	0.956	1.362

THUNDER BAY ISLAND, MICHIGAN.—ALTITUDE 614 FEET.

TABLE B.—Maximum, minimum, and mean barometrical pressure for each month from the year 1859 to 1865 inclusive, reduced to 32° Fahr. + 28 inches.

Year.	July.			August.			September.			October.			November.			December.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1859	1.806	0.835	1.406	1.625	1.161	1.351	1.839	0.753	1.384	1.688	0.979	1.377	1.967	0.557	1.423	2.069	0.969	1.406
1860	1.683	0.782	1.308	1.667	0.918	1.333	1.834	0.939	1.414	1.776	0.722	1.396	1.677	0.506	1.218	1.956	0.630	1.400
1861	1.604	0.872	1.306	1.656	1.120	1.412	1.903	1.053	1.393	1.747	0.668	1.335	1.771	0.744	1.261	1.917	0.820	1.450
1862	1.592	0.959	1.275	1.690	0.947	1.355	1.796	0.872	1.392	1.853	0.771	1.334	2.129	0.813	1.376	2.067	0.941	1.367
1863	1.640	1.072	1.349	1.630	0.883	1.363	1.840	0.895	1.447	1.950	0.864	1.400	1.866	0.772	1.300	1.977	0.705	1.430
1864	1.656	1.151	1.411	1.636	0.809	1.335	1.684	0.939	1.358	1.666	0.873	1.296	1.790	0.421	1.290	1.941	0.519	1.243
1865	1.701	0.980	1.402	1.652	1.048	1.457	1.700	1.171	1.442	1.815	0.658	1.398	2.070	0.957	1.417	....	....	(1.383)

THUNDER BAY ISLAND, MICHIGAN. + 28 INCHES.

TABLE B.—Maximum, minimum, and mean barometrical pressure reduced to 32° Fahr., for seasons.

Year.	Spring.			Summer.			Autumn.			Winter.			Year.			Range.
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	
1859	1.879	0.050	1.292	1.824	0.835	1.375	1.967	0.557	1.395	....	....	....	2.069	0.050	1.358	2.019
1860	1.984	0.481	1.286	1.683	0.732	1.313	1.834	0.506	1.343	2.069	0.551	1.346	1.984	0.481	1.321	1.503
1861	1.887	0.530	1.309	1.656	0.872	1.346	1.903	0.668	1.329	1.979	0.573	1.333	1.979	0.530	1.333	1.449
1862	1.916	0.700	1.354	1.735	0.879	1.327	2.129	0.771	1.367	1.917	0.765	1.421	2.129	0.700	1.309	1.429
1863	1.856	0.534	1.370	1.661	0.677	1.342	1.950	0.772	1.382	2.067	0.563	1.386	1.992	0.534	1.375	1.458
1864	1.765	0.493	1.295	1.799	0.786	1.392	1.790	0.421	1.315	1.977	0.640	1.312	1.941	0.421	1.312	1.520
1865	1.880	0.423	1.336	1.701	0.956	1.407	2.070	0.658	1.419	1.941	0.519	1.349	....	....	(1.389)	....

THUNDER BAY ISLAND, MICHIGAN.

TABLE B.—Maximum, minimum, and mean temperature for each month from the year 1859 to 1865 inclusive.

Year.	January.			February.			March.			April.			May.			June.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1859	38	— 4	22.8	37	1	23.3	46	13	32.3	48	23	34.9	58	36	46.0	72	35	53.6
1860	44	— 6	22.4	40	— 5	20.7	49	12	31.7	46	17	35.6	57	34	46.3	70	46	57.1
1861	35	1	21.6	46	—25	24.0	43	—11	24.0	62	22	37.6	69	25	43.8	79	41	55.5
1862	37	2	22.6	38	—10	19.9	45	9	29.8	53	17	37.0	64	31	46.7	76	40	57.0
1863	38	0	27.7	36	— 6	23.5	36	8	25.6	45	8	37.7	56	34	48.9	66	40	58.6
1864	47	—17	22.4	47	—20	24.0	44	—10	26.4	52	25	37.6	69	30	47.1	90	35	60.5
1865	40.5	— 7.5	19.2	40	— 6.5	23.6	51	—11.5	29.7	59	10	38.4	72	27	47.0	77	39	58.4

Year.	July.			August.			September.			October.			November.			December.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1859	79	44	63.6	76	51	65.7	71	36	55.2	72	29	43.1	51	25	35.8	36	—5	19.5
1860	76	50	61.5	73	51	62.8	73	34	55.0	61	32	47.0	60	11	36.2	38	5	24.5
1861	82	48	63.0	81	49	65.0	77	40	58.4	70	31	49.6	52	20	37.5	51	7	31.8
1862	85	47	65.3	82	50	66.4	77	41	58.4	70	28	47.3	50	20	34.9	42	3	29.1
1863	73	44	64.9	81	40	63.9	73	33	54.9	65	29	45.1	54	8	37.0	45	2	27.6
1864	90	51	67.6	93	51	70.3	74	39	57.0	64	29	45.4	54	16	36.0	46	1	23.8
1865	80	41	62.9	82	46	64.9	81	41	64.8	72.5	26	46.6	60.5	23	41.2	....	....	(26.0)

THUNDER BAY ISLAND, MICHIGAN.

TABLE B.—Maximum, minimum, and mean temperature for seasons and years from 1859 to 1865 inclusive.

Year.	Spring.			Summer.			Autumn.			Winter.			Year.			Range.
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	
1859	58	13	37.8	79	35	61.0	72	25	44.7	....	....	....	79	— 5	41.3	84
1860	57	12	37.9	76	46	60.5	73	11	46.1	44	— 6	20.9	76	— 6	41.7	82
1861	69	—11	35.1	82	41	61.2	77	20	48.5	46	—25	23.4	82	—25	42.6	107
1862	64	9	37.9	85	40	62.9	77	20	46.9	51	—10	24.8	85	—10	42.9	95
1863	56	8	37.4	81	40	62.5	73	8	45.7	42	— 6	26.8	81	— 6	42.9	87
1864	69	—10	37.0	93	35	66.1	74	16	46.1	47	—20	24.7	93	—20	43.2	113
1865	72	—11.5	38.4	82	39	62.1	81	26	50.9	46	— 7.5	22.2	82	—11.5	(43.8)	93.5

THUNDER BAY ISLAND, MICHIGAN.

TABLE B.—Amount of rain and melted snow for months, seasons, and years, in United States inches and decimals.

Year.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Spring.	Summer.	Autumn.	Winter.	Year.
1859	5.97	2.53	4.28	3.79	1.38	2.34	3.06	0.70	3.95	2.04	4.51	2.59	9.45	6.10	10.50	....	37.14
1860	2.26	3.66	1.52	2.97	1.69	1.69	2.37	2.26	3.45	2.46	1.32	2.23	6.18	6.32	7.23	8.51	27.88
1861	4.35	4.04	3.08	2.57	2.43	3.55	4.18	0.98	2.48	2.98	3.33	2.12	8.08	8.71	8.79	10.62	36.09
1862	2.78	1.27	1.69	3.91	3.19	0.97	2.20	5.49	8.58	4.05	1.39	1.40	8.79	8.66	14.02	6.17	36.92
1863	3.50	2.12	3.23	1.73	2.10	2.06	4.59	2.41	1.19	2.63	2.69	3.04	7.06	9.06	6.51	7.02	31.29
1864	2.13	2.99	2.63	3.03	1.68	2.06	1.92	0.87	2.22	3.24	3.49	5.67	7.34	4.85	8.95	8.16	31.93
1865	1.43	1.94	3.41	3.46	2.01	3.63	1.72	3.02	4.98	2.17	0.39	(3.17)	8.88	8.37	7.54	9.04	(31.32)

TAWAS CITY, MICHIGAN.—ALTITUDE 587 FEET.

TABLE B.—Maximum, minimum, and mean barometrical pressure for each month from the year 1859 to 1866 inclusive, reduced to 32° Fahr. + 28 inches.

Year.	January.			February.			March.			April.			May.			June.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1859	1.941	0.893	1.432	1.704	0.867	1.343	1.899	0.059	1.149	1.732	0.556	1.321	1.849	0.891	1.387	1.900	1.022	1.397
1860	1.883	0.725	1.338	1.831	0.595	1.338	1.696	0.734	1.302	1.981	0.570	1.318	1.721	0.901	1.284	1.633	0.627	1.294
1861	1.989	0.770	1.396	1.772	0.573	1.258	1.862	0.618	1.355	1.809	0.853	1.285	1.705	0.545	1.302	1.584	0.870	1.328
1862	1.948	0.736	1.433	1.794	0.670	1.364	1.595	0.655	1.247	1.854	0.746	1.447	1.763	0.856	1.357	1.773	0.938	1.370
1863	1.936	0.635	1.351	2.017	0.715	1.436	1.862	1.000	1.389	1.814	0.628	1.417	1.659	0.770	1.348	1.682	0.720	1.337
1864	1.842	0.750	1.320	1.818	0.664	1.219	1.758	0.556	1.256	1.751	0.959	1.344	1.515	0.330	1.259	1.737	0.867	1.437
1865	1.875	0.950	1.357	1.894	0.796	1.458	1.802	0.558	1.295	1.896	0.567	1.372	1.746	0.852	1.334	1.599	0.962	1.343
1866	2.611	0.823	1.495	1.974	0.919	1.417	1.795	0.685	1.423	1.741	0.845	1.358	1.602	0.801	1.254	1.660	0.813	1.223

Year.	July.			August.			September.			October.			November.			December.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1859	1.915	0.907	1.409	1.605	1.161	1.363	1.841	0.792	1.432	1.707	1.018	1.399	2.132	0.690	1.391	2.041	0.983	1.393
1860	1.676	0.807	1.310	1.667	1.020	1.343	1.848	0 980	1.445	1.750	0.771	1.406	1.641	0.542	1.304	2.007	0.658	1.420
1861	1.604	0.877	1.309	1.615	1.102	1.406	1.850	1.046	1.368	1.832	0.689	1.353	1.744	0.752	1.260	1.914	0.849	1.469
1862	1.669	0.946	1.305	1.723	0.997	1.387	1.774	0.948	1.430	1.870	0.942	1.373	2.130	0.846	1.399	2.109	0.951	1.405
1863	1.692	1.111	1.376	1.687	0.995	1.406	1.892	0.955	1.484	1.986	0.922	1.428	1.892	0.861	1.333	1.937	0.666	1.435
1864	1.629	1.147	1.404	1.692	0.860	1.328	1.656	0.949	1.358	1.684	0.708	1.297	1.798	0.441	1.299	2.039	0.579	1.257
1865	1.704	0.996	1.384	1.687	1.065	1.444	1.702	1.114	1.421	1.773	0.648	1.401	2.041	0.686	1.408	1.846	0.860	1.395
1866	1.584	0.913	1.308	1.731	0.967	1.320	1.650	0.935	1.360	1.907	0.735	1.428	1.573	0.935	1.262	1.924	0.472	1.327

TAWAS CITY, MICHIGAN. + 28 INCHES.

TABLE B.—Maximum, minimum, and mean barometrical pressure reduced to 32° Fahr., for seasons.

Year.	Spring.			Summer.			Autumn.			Winter.			Year.			Range.
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	
1859	1. 899	0. 059	1. 285	1. 900	0. 907	1. 390	2. 132	0. 690	1. 407	....	....	....	2. 132	0. 059	1. 368	2. 073
1860	1. 981	0. 570	1. 301	1. 676	0. 627	1. 315	1. 848	0. 542	1. 385	2. 041	0. 595	1. 356	2. 007	0. 542	1. 342	1. 465
1861	1. 862	0. 545	1. 314	1. 615	0. 870	1. 347	1. 850	0. 689	1. 327	2. 007	0. 573	1. 358	1. 989	0. 545	1. 341	1. 444
1862	1. 854	0. 655	1. 350	1. 773	0. 938	1. 354	2. 130	0. 846	1. 400	1. 948	0. 670	1. 422	2. 130	0. 655	1. 376	1. 475
1863	1. 862	0. 628	1. 385	1. 692	0. 720	1. 373	1. 986	0. 861	1. 415	2. 109	0. 635	1. 414	2. 017	0. 628	1. 399	1. 389
1864	1. 758	0. 556	1. 286	1. 737	0. 860	1. 380	1. 798	0. 441	1. 318	1. 937	0. 664	1. 325	2. 039	0. 441	1. 314	1. 598
1865	1. 896	0. 558	1. 334	1. 704	0. 962	1. 390	2. 041	0. 648	1. 410	2. 039	0. 579	1. 357	2. 041	0. 558	1. 384	1. 483
1866	1. 795	0. 685	1. 345	1. 731	0. 813	1. 284	1. 907	0. 735	1. 350	2. 611	0. 823	1. 436	2. 611	0. 472	1. 348	2. 139

TAWAS CITY, MICHIGAN.

TABLE B.—Maximum, minimum, and mean temperature for each month from the year 1859 to 1866 inclusive.

Year.	January.			February.			March.			April.			May.			June.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1859	41	0	24. 2	44	0	25. 7	56	11	35. 1	58	24	38. 7	66	35	52. 3	75	36	58. 7
1860	46	— 2	23. 4	48	—16	21. 6	52	13	34. 8	53	15	39. 6	71	30	54. 0	78	52	63. 5
1861	39	— 9	21. 2	47	—25	24. 8	47	—10	36. 3	60	26	40. 3	65	28	47. 7	78	44	61. 9
1862	37	— 5	20. 9	37	— 9	20. 9	41	7	28. 9	57	21	38. 8	71	29	50. 6	76	39	58. 3
1863	43	—11	28. 2	41	2	24. 7	42	6	28. 0	60	9	40. 4	81	33	53. 8	76	42	59. 5
1864	50	—16	21. 9	52	—14	25. 5	46	— 5	27. 7	54	26	39. 3	78	29	53. 8	90	32	63. 3
1865	39	— 4	18. 5	57	— 9	23. 3	54. 5	—10	30. 8	61	18	41. 5	73	28	52. 4	85	39	66. 5
1866	40	—25	18. 7	40	—16	19. 6	48	— 1	24. 3	....	18	40. 6	....	17	48. 7	....	27	62. 1

TAWAS CITY, MICHIGAN.

TABLE B.—Maximum, minimum, and mean temperature for each month from the year 1859 to 1866 inclusive.

Year.	July.			August.			September.			October.			November.			December.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1859	83	47	68.4	81	48	68.7	73	39	57.9	72	26	45.0	54	24	37.2	41	—6	20.6
1860	78	51	66.6	79	50	65.5	77	41	57.3	59	33	48.8	55	11	36.9	41	—2	25.0
1861	80	48	66.2	82	40	67.4	85	31	60.0	74	23	50.6	59	17	36.4	60	3	31.9
1862	82	44	67.0	86	45	67.4	79	43	60.3	75	20	48.3	59	17	35.2	51	7	29.9
1863	84	42	65.7	85	41	65.3	77	28	56.1	63	23	43.4	54	12	37.1	47	2	27.7
1864	86	48	69.9	87	43	69.4	75	35	57.1	59	29	44.3	53	13	35.5	45	—6	23.0
1865	83	40.5	61.7	81	42	65.8	83.5	39	66.0	72	27	45.8	59	25	38.8	47	—2	25.7
1866	....	46	71.2	....	31.5	61.7	....	31	56.1	....	30	53.5	....	22	39.9	....	6	24.3

TAWAS CITY, MICHIGAN.

TABLE B.—Maximum, minimum, and mean temperature for seasons and years from 1859 to 1866 inclusive.

Year.	Spring.			Summer.			Autumn.			Winter.			Year.			Range.
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	
1859	66	11	42.0	83	36	65.2	73	24	46.7	....	....	....	83	— 6	44.4	89
1860	71	13	42.8	79	50	65.2	77	11	47.6	48	—16	21.9	79	—16	44.7	95
1861	65	—10	38.1	82	40	65.1	85	17	49.0	47	—25	23.7	85	—25	44.5	110
1862	71	7	39.4	86	39	64.2	79	17	47.9	60	— 9	24.6	86	— 9	43.9	95
1863	81	6	40.7	85	41	63.5	77	12	45.5	51	—11	27.6	85	—11	44.1	96
1864	78	— 5	40.3	90	32	67.5	75	13	46.0	52	—16	25.0	90	—16	44.3	106
1865	73	—10	41.6	85	39	64.7	83.5	25	50.2	57	— 9	21.6	85	—10	44.7	95
1866	....	— 1	37.9	....	27	65.0	....	22	49.8	47	—25	21.3	....	—25	43.4	....

TAWAS CITY, MICHIGAN.

TABLE B.—Amount of rain and melted snow for months, seasons, and years, in United States inches and decimals.

Year.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Spring.	Summer.	Autumn.	Winter.	Year.
1859	1.07	0.26	2.89	2.10	1.65	1.25	1.22	0.37	1.91	1.38	2.82	1.74	6.64	2.84	6.11	....	18.66
1860	1.60	0.97	1.39	1.85	1.59	1.07	1.62	2.38	0.95	2.57	0.85	0.85	4.83	5.07	4.37	4.31	17.69
1861	1.44	1.12	2.04	2.81	1.78	1.24	1.70	2.22	2.08	1.29	1.97	0.91	6.63	5.16	5.34	3.41	20.60
1862	1.62	0.53	1.85	2.20	1.40	1.33	2.24	3.58	4.56	2.93	1.76	0.74	5.45	7.15	9.25	3.06	24.74
1863	2.06	1.53	2.51	1.92	2.84	1.17	3.69	4.67	0.46	3.97	3.15	3.02	7.27	9.53	7.58	4.33	30.99
1864	1.81	1.49	1.10	2.86	1.20	0.82	1.19	0.30	1.06	2.37	3.14	1.67	5.16	2.31	6.57	6.32	19.01
1865	0.50	1.20	3.64	3.99	0.73	3.69	1.71	1.61	6.65	2.04	0.82	0.77	8.36	7.01	9.51	3.37	27.35
1866	1.51	0.60	1.90	0.54	2.49	3.98	0.30	2.75	2.51	0.26	1.27	1.45	4.93	7.03	4.04	2.88	19.56

MILWAUKEE, WISCONSIN.—ALTITUDE 591 FEET.

TABLE B.—Maximum, minimum, and mean barometrical pressure for each month from the year 1859 to 1866 inclusive, reduced to 32° Fahr. + 28 inches.

Year.	January.			February.			March.			April.			May.			June.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1859	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
1860	2.003	0.758	1.393	1.870	0.529	1.378	1.777	0.727	1.345	1.999	0.511	1.322	1.649	0.805	1.250	1.641	0.770	1.325
1861	1.863	0.665	1.374	1.767	0.635	1.264	1.862	0.729	1.364	1.604	0.831	1.242	1.753	0.447	1.293	1.593	1.002	1.350
1862	2.011	1.051	1.451	1.873	0.641	1.404	1.633	0.655	1.222	1.702	0.738	1.399	1.743	0.904	1,355	1.622	1.008	1.361
1863	1.706	0.808	1.338	1.892	0.811	1.476	1.800	0.972	1.389	1.746	0.768	1.389	1.595	0.875	1.329	1.730	0.943	1.363
1864	1.868	0.877	1.354	1.913	0.637	1.273	1.664	0.677	1.227	1.650	1.060	1.320	1.590	0.983	1.271	1.689	0.965	1.414
1865	1.806	1.073	1.397	1.854	0.875	1.415	1.736	0.721	1.299	1.879	0.787	1.332	1.585	0.903	1.308	1.588	0.968	1.326
1866	2.503	0.683	1.484	1.921	0.927	1.456	1.888	0.720	1.455	1.710	0.921	1.327	1.603	0.769	1.278	1.608	0.813	1.258

MILWAUKEE, WISCONSIN.—ALTITUDE 591 FEET.

TABLE B.—Maximum, minimum, and mean barometrical pressure for each month from the year 1859 to 1866 inclusive, reduced to 32° Fahr. + 28 inches.

Year.	July.			August.			September.			October.			November.			December.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1859	....	....	....	1. 522	1. 074	1. 263	1. 713	0. 803	1. 288	1. 654	0. 828	1. 310	1. 788	0. 549	1. 278	1. 812	0. 816	1. 323
1860	1. 683	0. 902	1. 331	1. 604	1. 118	1. 358	1. 820	0. 971	1. 442	1. 784	0. 750	1. 409	1. 680	0. 589	1. 286	1. 952	0. 760	1. 457
1861	1. 639	1. 027	1. 340	1. 621	1. 166	1. 413	1. 815	1. 104	1. 402	1. 786	0. 658	1. 342	1. 675	0. 703	1. 270	1. 958	0. 839	1. 488
1862	1. 623	1. 047	1. 313	1. 702	1. 052	1. 389	1. 717	1. 075	1. 409	1. 945	0. 945	1. 387	2. 034	0. 910	1. 420	2. 032	0. 911	1. 416
1863	1. 675	1. 181	1. 370	1. 691	0. 971	1. 381	1. 828	0. 995	1. 351	1. 967	0. 738	1. 401	1. 877	0. 843	1. 354	1. 854	0. 858	1. 408
1864	1. 696	1. 139	1. 395	1. 661	1. 007	1. 345	1. 582	0. 935	1. 314	1. 696	0. 836	1. 298	1. 757	0. 767	1. 291	1. 970	0. 552	1. 284
1865	1. 649	1. 015	1. 389	1. 632	1. 128	1. 423	1. 650	0. 957	1. 402	1. 707	0. 926	1. 394	1. 943	0. 687	1. 409	1. 910	0. 738	1. 367
1866	1. 616	1. 035	1. 338	1. 661	1. 017	1. 357	1. 639	0. 925	1. 365	1. 895	0. 687	1. 423	2. 040	0. 898	1. 350	1. 842	0. 615	1. 353

MILWAUKEE, WISCONSIN. + 28 INCHES.

TABLE B.—Maximum, minimum, and mean barometrical pressure reduced to 32° Fahr., for seasons.

Year.	Spring.			Summer.			Autumn.			Winter.			Year.			Range.
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	
1859	....	....	....	....	....	....	1. 788	0. 549	1. 292	....	....	....	....	....	....	....
1860	1. 999	0. 511	1. 305	1. 683	0. 770	1. 338	1. 820	0. 589	1. 379	2. 003	0. 529	1. 365	2. 003	0. 511	1. 358	1. 492
1861	1. 862	0. 447	1. 299	1. 639	1. 002	1. 367	1. 815	0. 658	1. 338	1. 952	0. 635	1. 365	1. 958	0. 447	1. 345	1. 511
1862	1. 743	0. 655	1. 325	1. 702	1. 008	1. 354	2. 034	0. 910	1. 405	2. 011	0. 641	1. 448	2. 034	0. 641	1. 377	1. 393
1863	1. 800	0. 768	1. 369	1. 730	0. 943	1. 371	1. 967	0. 738	1. 369	2. 032	0. 808	1. 410	1. 967	0. 738	1. 379	1. 129
1864	1. 664	0. 677	1. 273	1. 696	0. 965	1. 335	1. 757	0. 767	1. 319	1. 913	0. 637	1. 345	1. 970	0. 552	1. 307	1. 418
1865	1. 879	0. 721	1. 313	1. 649	0. 968	1. 379	1. 943	0. 687	1. 402	1. 970	0. 552	1. 365	1. 943	0. 721	1. 373	1. 222
1866	1. 888	0. 720	1. 353	1. 661	0. 813	1. 318	2. 040	0. 687	1. 379	2. 503	0. 683	1. 436	2. 503	0. 615	1. 370	1. 888

MILWAUKEE, WISCONSIN.

TABLE B.—Maximum, minimum, and mean temperature for each month from the year 1859 to 1866 inclusive.

Year.	January.			February.			March.			April.			May.			June.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1859	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
1860	48	—14	24.0	49	— 3	27.4	69	21	40.3	75	30	43.6	82	33	56.2	83	53	64.2
1861	42	—10	21.2	56	—16	27.5	62	5	32.0	76	30	44.9	85	27	50.7	87	40	64.6
1862	40	—21	20.3	41	—16	18.7	53	4	32.4	70	22	41.6	83	33	53.6	87	39	60.8
1863	50	5	29.8	47	—12	26.8	48	11	31.4	67	22	45.0	84	32	55.5	90	43	63.7
1864	49	—30	18.8	48	—18	26.0	52	— 1	30.7	61	30	40.1	91	30	55.3	97	39	65.2
1865	42	— 8	18.6	50	5	27.1	58	— 5	31.7	72	16	43.7	85	34	52.9	94	42	67.2
1866	44	—10	19.5	50	—18	19.1	52	3	27.1	74	24	43.5	88	32	50.4	92	42	64.3

Year.	July.			August.			September.			October.			November.			December.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1859	......	......	......	92	55	......	81	45	59.3	79	30	48.2	69	19	40.6	41	—16	19.6
1860	84	49	69.0	85	44	66.8	82	40	58.7	75	32	50.0	58	— 3	36.1	45	— 5	24.8
1861	95	44	68.5	97	49	68.1	83	38	63.4	71	27	50.1	53	3	36.8	59	— 4	31.1
1862	92	47	70.9	93	50	70.6	87	42	62.0	81	23	51.2	55	20	35.2	55	0	30.6
1863	90	44	68.6	91	41	69.1	87	31	59.4	66	28	43.8	59	7	36.8	57	2	29.2
1864	94	52	71.3	92	49	69.9	84	40	60.7	60	28	45.7	60	3	35.3	53	—19	20.2
1865	91	44	63.4	89	45	67.1	88	42	68.4	77	25	48.3	61	26	40.5	46	— 9	22.9
1866	97	50	73.0	90	46	66.1	76	36	57.5	78	27	50.1	60	21	39.0	49	— 5	23.2

MILWAUKEE, WISCONSIN.

TABLE B.—Maximum, minimum, and mean temperature for seasons and years from 1859 to 1866 inclusive.

Year.	Spring.			Summer.			Autumn.			Winter.			Year.			Range.
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	
1859	....	....	....	....	....	....	81	19	49.4	....	....	....	....	....	....	....
1860	82	21	46.7	85	44	66.7	82	— 3	48.3	49	—16	23.7	85	—14	46.8	99
1861	85	5	42.5	97	40	67.1	83	3	50.1	56	—16	24.5	97	—16	46.6	113
1862	83	4	42.5	93	39	67.4	87	20	49.4	59	—21	23.4	93	—21	45.5	114
1863	84	11	44.0	91	41	67.1	87	7	46.7	55	—12	29.1	91	—12	46.6	103
1864	91	— 1	42.0	97	39	68.8	84	3	47.2	57	—30	24.7	97	—30	44.9	127
1865	85	— 5	42.8	94	42	65.9	88	25	52.4	53	—19	22.0	94	— 9	46.0	103
1866	88	3	40.3	97	42	67.8	78	21	48.9	50	—18	20.5	97	—18	44.4	115

MILWAUKEE, WISCONSIN.—ALTITUDE 591 FEET.

TABLE B.—Amount of rain and melted snow for months, seasons, and years, in United States inches and decimals.

Year.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Spring.	Summer.	Autumn.	Winter.	Year.
1859	....	....	....	....	....	....	....	0.20	3.54	1.52	3.12	0.64	....	....	8.18	....	....
1860	0.53	1.40	0.33	0.33	3.34	4.15	1.95	2.80	2.50	2.09	2.61	2.71	4.00	8.90	7.20	2.57	24.74
1861	2.58	3.07	1.90	3.12	4.32	1.90	4.77	2.21	3.39	1.48	1.59	1.55	9.34	8.88	6.46	8.36	31.88
1862	3.41	0.48	2.10	5.34	5.11	3.86	4.09	2.94	5.40	3.26	1.28	1.37	12.55	10.89	9.94	5.44	39.12
1863	3.93	1.85	2.48	1.04	5.21	0.79	2.41	2.62	1.02	2.97	3.51	4.57	8.73	5.82	7.50	7.15	32.40
1864	2.15	0.42	2.52	3.01	2.74	0.03	7.07	0.61	2.93	1.63	2.61	1.99	8.27	7.71	7.17	7.14	27.71
1865	0.22	3.58	3.89	1.96	1.11	3.57	1.78	4.34	4.67	4.13	0.31	0.52	6.96	9.69	9.11	5.79	30.08
1866	2.58	1.64	1.50	3.04	2.06	4.83	2.73	3.95	3.88	2.76	1.32	3.00	6.60	11.51	7.96	4.74	33.29

GRAND HAVEN, MICHIGAN.—ALTITUDE 588 FEET.

TABLE B.—Maximum, minimum, and mean barometrical pressure for each month from the year 1859 to 1863, inclusive, reduced to 32° Fahr. + 28 inches.

Year.	January.			February.			March.			April.			May.			June.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1859	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
1860	1.971	0.852	1.409	1.805	0.582	1.349	1.705	0.738	1.339	1.867	0.568	1.323	1.683	0.567	1.269	1.632	0.695	1.326
1861	1.845	0.620	1.357	1.718	0.352	1.262	1.827	0.499	1.362	1.675	0.796	1.259	1.717	0.579	1.309	1.588	1.098	1.369
1862	1.898	0.957	1.422	1.750	0.625	1.354	1.591	0.698	1.200	1.633	0.787	1.385	1.703	0.872	1.333	1.694	0.992	1.345
1863	1.772	0.832	1.327	1.880	0.890	1.467	1.786	0.954	1.370	1.728	0.752	1.377	1.584	0.831	1.330	1.691	0.910	1.348

Year.	July.			August.			September.			October.			November.			December.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1859	......	......	......	......	......	......	1.818	0.950	1.416	1.702	0.910	1.445	1.974	0.698	1.427	2.248	0.959	1.448
1860	1.660	0.892	1.315	1.609	1.099	1.353	1.807	0.960	1.441	1.754	0.907	1.403	1.607	0.588	1.267	2.127	0.723	1.448
1861	1.673	0.972	1.367	1.641	1.204	1.414	1.864	1.102	1.399	1.794	0.665	1.343	1.735	0.697	1.245	1.879	0.967	1.469
1862	1.588	1.075	1.314	1.689	1.033	1.390	1.734	1.094	1.428	1.842	0.970	1.387	1.973	0.649	1.360	2.059	0.838	1.405
1863	......	1.152	1.369	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......

GRAND HAVEN, MICHIGAN. + 28 INCHES.

TABLE B.—Maximum, minimum, and mean barometrical pressure reduced to 32° Fahr. for seasons.

Year.	Spring.			Summer.			Autumn.			Winter.			Year.			Range.
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	
1859	......	......	......	......	......	......	1.974	0.698	1.436	......	......	......	......	......	......	......
1860	1.867	0.567	1.310	1.660	0.695	1.331	1.807	0.588	1.370	2.248	0.582	1.402	2.127	0.567	1.353	1.560
1861	1.827	0.499	1.310	1.673	0.972	1.383	1.864	0.665	1.329	2.127	0.352	1.356	1.879	0.352	1.346	1.527
1862	1.703	0.698	1.306	1.694	0.992	1.349	1.973	0.649	1.391	1.898	0.625	1.415	2.059	0.625	1.360	1.434
1863	1.786	0.752	......	......	......	......	......	......	......	2.059	0.832	1.400	......	......	......	......

GRAND HAVEN, MICHIGAN.

TABLE B.—Maximum, minimum, and mean temperature for each month from the year 1859 to 1863, inclusive.

Year.	January.			February.			March.			April.			May.			June.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1859																		
1860	40	0	26.2	52	5	25.8	63	21	37.3	67	27	45.2	77	40	60.1	81	50	66.0
1861	35	—4	24.0	50	—16	27.6	51	1	31.1	74	23	46.1	76	27	51.5	88	44	66.0
1862	41	—5	21.8	40	0	22.1	47	4	31.9	68	25	43.6	83	32	54.6	85	40	64.4
1863	65	7	31.2	50	2	26.6	48	10	31.6	76	8	46.1	88	30	58.1	88	28	65.2

Year.	July.			August.			September.			October.			November.			December.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1859				81	48		81	48	59.2	70	28	47.1	62	29	40.2	36	7	23.6
1860	84	59	70.7	86	48	67.7	79	28	57.9	65	20	49.1	60	9	36.6	47	6	25.1
1861	86	46	67.7	91	50	70.9	77	41	61.4	70	29	51.7	55	19	37.7	57	0	33.1
1862	87	48	72.3	89	50	72.2	80	39	63.0	75	17	51.4	59	11	37.5	52	6	33.1
1863	90	33	69.8															

GRAND HAVEN, MICHIGAN.

TABLE B.—Maximum, minimum, and mean temperature for seasons and years from 1859 to 1863, inclusive.

Year.	Spring.			Summer.			Autumn.			Winter.			Year.			Range.
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	
1859							81	29	48.9							
1860	77	21	47.5	86	48	68.1	79	9	47.9	52	0	25.2	86	0	47.3	86
1861	76	1	42.9	91	44	68.2	77	19	50.3	50	—16	25.6	91	—16	47.4	107
1862	83	4	43.4	89	40	69.6	80	11	50.7	57	— 5	25.7	89	— 5	47.2	94
1863	88	8	45.3							65	2	30.3				

GRAND HAVEN, MICHIGAN.

TABLE B.—Amount of rain and melted snow for months, seasons, and years, in United States inches and decimals.

Year.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Spring.	Summer.	Autumn.	Winter.	Year.
1859	....	....	....	....	....	....	....	....	2.24	3.38	2.36	3.68	....	....	7.98	....	....
1860	1.60	1.60	0.64	0.96	3.46	2.54	3.76	3.88	3.40	2.30	3.99	0.82	5.06	10.18	9.69	6.88	28.95
1861	1.66	1.06	0.66	0.68	2.60	1.51	2.85	3.48	4.58	2.54	1.97	1.48	3.94	7.84	9.09	3.54	25.07
1862	1.41	1.04	2.22	1.66	2.74	2.12	1.36	4.26	0.20	1.07	2.86	0.96	6.62	7.77	4.13	3.93	21.93
1863	1.82	1.42	1.12	0.94	3.66	0.56	0.90	....	....	....	....	....	5.72	....	....	4.20	....

DETROIT, MICHIGAN.—ALTITUDE 587 FEET.

TABLE B.—Maximum, minimum, and mean barometrical pressure for each month from the year 1859 to 1866 inclusive, reduced to 32° Fahr. + 28 inches.

Year.	January.			February.			March.			April.			May.			June.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1859	1.949	0.873	1.469	1.693	0.940	1.353	1.821	0.469	1.254	1.700	0.699	1.239	1.752	0.994	1.373	....	....	....
1860	1.964	0.926	1.384	1.832	0.637	1.433	1.641	0.882	1.302	1.958	0.562	1.314	1.686	0.991	1.274	1.612	0.608	1.296
1861	1.924	0.774	1.384	1.814	0.730	1.297	1.814	0.776	1.363	1.738	0.779	1.261	1.695	0.658	1.292	1.559	1.019	1.329
1862	1.971	0.861	1.423	1.780	0.663	1.377	1.556	0.690	1.213	1.789	0.793	1.416	1.702	0.918	1.345	1.782	0.933	1.333
1863	1.948	0.656	1.354	1.976	0.807	1.477	1.759	0.807	1.348	1.701	0.581	1.313	1.599	0.750	1.262	1.618	0.795	1.283
1864	1.888	0.914	1.403	1.918	0.690	1.288	1.705	0.598	1.269	1.718	0.951	1.312	1.548	0.964	1.249	1.721	0.921	1.427
1865	1.910	1.043	1.384	1.908	0.866	1.425	1.859	0.695	1.309	1.798	0.836	1.365	1.666	1.006	1.327	1.540	1.009	1.369
1866	2.630	0.844	1.506	2.073	1.033	1.444	1.872	0.872	1.468	1.752	0.852	1.398	1.654	0.664	1.289	1.727	0.813	1.314

Year.	July.			August.			September.			October.			November.			December.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1859	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1.975	0.876	1.403
1860	1.641	0.963	1.326	1.704	1.035	1.345	1.800	1.106	1.442	1.698	0.790	1.394	1.630	0.637	1.272	1.988	0.760	1.439
1861	1.579	0.933	1.331	1.620	1.181	1.398	1.810	1.028	1.391	1.778	0.735	1.361	1.686	0.771	1.258	1.951	1.001	1.499
1862	1.666	1.046	1.305	1.678	1.155	1.396	1.707	0.983	1.429	1.799	0.881	1.401	2.029	0.879	1.386	2.039	0.852	1.415
1863	1.638	1.132	1.323	1.786	1.056	1.387	1.869	1.034	1.464	1.932	0.908	1.430	1.868	0.881	1.376	1.958	0.797	1.464
1864	1.612	1.129	1.409	1.680	0.946	1.325	1.598	1.028	1.344	1.609	0.941	1.305	1.796	0.708	1.342	2.009	0.704	1.289
1865	1.654	1.052	1.392	1.635	1.180	1.445	1.660	1.046	1.448	1.743	0.708	1.400	1.982	0.670	1.461	2.022	0.767	1.408
1866	1.692	1.105	1.413	1.727	0.986	1.386	1.756	1.001	1.430	1.979	1.014	1.492	2.099	0.907	1.428	1.936	0.636	1.391

DETROIT, MICHIGAN. + 28 INCHES.

TABLE B.—Maximum, minimum, and mean barometrical pressure reduced to 32° Fah., for seasons.

Date.	Spring.			Summer.			Autumn.			Winter.			Year.			Range.
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	
1859	1.821	0.469	1.288	......	......	......	......	......	......	......	......	......	......	......	......	......
1860	1.958	0.562	1.296	1.704	0.608	1.322	1.800	0.637	1.369	1.975	0.637	1.407	1.988	0.562	1.352	1.426
1861	1.814	0.658	1.305	1.620	0.933	1.352	1.810	0.735	1.336	1.988	0.730	1.373	1.951	0.658	1.347	1.293
1862	1.789	0.690	1.325	1.782	0.933	1.345	2.029	0.879	1.405	1.971	0.663	1.433	2.039	0.663	1.370	1.376
1863	1.759	0.581	1.308	1.786	0.795	1.331	1.932	0.881	1.423	2.039	0.656	1.415	1.976	0.581	1.373	1.395
1864	1.718	0.598	1.277	1.721	0.921	1.387	1.796	0.708	1.330	1.958	0.690	1.385	2.009	0.598	1.330	1.411
1865	1.859	0.695	1.330	1.654	1.006	1.402	1.982	0.798	1.436	2.009	0.704	1.366	2.022	0.695	1.394	1.327
1866	1.872	0.664	1.385	1.727	0.813	1.371	2.099	0.907	1.450	2.630	0.767	1.453	2.630	0.664	1.413	1.966

DETROIT, MICHIGAN.

TABLE B.—Maximum, minimum, and mean temperature for each month from the year 1859 to 1866 inclusive.

Year.	January.			February.			March.			April.			May.			June.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1859	......	......	33.1	......	......	32.2	......	......	43.3	......	......	46.9	......	......	67.0	......	......	......
1860	49	—14	26.9	60	9	27.6	67	15	39.6	75	30	44.9	83	32	60.6	87	46	66.4
1861	43	1	24.3	64	—14	30.1	75	6	33.5	78	29	47.9	80	25	52.9	87	40	67.5
1862	47	4	44.5	47	1	25.1	49	9	32.3	89	28	46.2	80	33	56.7	84	41	64.0
1863	53	— 3	31.1	49	3	27.2	59	9	31.4	74	12	45.8	86	36	60.6	91	39	64.6
1864	63	—19	24.6	60	— 5	29.4	61	5	33.4	60	29	44.2	87	33	59.4	95	38	67.7
1865	42	1	21.5	48	— 2	28.0	70	9	38.4	74	25	48.2	85	33	58.5	91	46	72.3
1866	57	—14	22.3	50	—14	25.1	56	9	29.4	78	24	47.9	80	27	52.4	88	44	64.7

DETROIT, MICHIGAN.

Table B.—Maximum, minimum, and mean temperature for each month from the year 1859 to 1866 inclusive.

Year.	July.			August.			September.			October.			November.			December.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1859	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	39	0	21.8
1860	89	48	68.6	88	42	68.1	81	33	57.9	74	29	50.2	66	7	37.3	41	— 3	25.1
1861	89	46	69.3	98	47	70.1	82	39	62.1	73	30	52.7	58	21	38.9	65	6	35.1
1862	95	48	72.4	91	49	71.6	86	41	63.4	82	23	51.3	70	24	38.2	58	10	33.5
1863	87	43	69.2	90	37	69.8	84	31	59.7	75	27	47.2	67	16	41.9	54	11	32.4
1864	95	53	74.3	93	46	71.4	82	37	60.7	75	28	47.7	80	18	38.0	55	— 4	25.8
1865	94	45	67.4	89	41	69.2	88	42	71.8	78	26	49.6	69	21	40.1	59	1	29.5
1866	92	50	72.1	82	41	64.0	82	34	57.5	77	29	51.6	61	19	38.7	54	6	25.9

DETROIT, MICHIGAN.

Table B.—Maximum, minimum, and mean temperature for seasons and years from 1859 to 1866 inclusive.

Year.	Spring.			Summer.			Autumn.			Winter.			Year.			Range.
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	
1859	....	....	52.8	....	....	....	....	....	....	....	....	....	....	....	....	....
1860	83	15	48.3	89	42	67.7	81	7	48.5	60	—14	25.4	89	—14	47.8	103
1861	80	6	44.7	98	40	69.0	82	21	51.3	64	—14	26.5	98	—14	48.7	112
1862	89	9	45.1	95	41	69.4	86	23	51.0	65	1	34.9	95	1	48.3	94
1863	86	9	45.9	91	37	67.9	84	16	49.6	58	— 3	30.6	91	— 3	48.4	94
1864	87	5	45.7	95	38	71.1	82	18	48.8	63	—19	28.8	95	—19	48.1	114
1865	85	9	48.4	94	41	69.6	88	21	52.8	55	— 4	25.1	94	— 2	49.3	96
1866	80	9	43.2	92	41	66.9	82	19	49,3	59	—14	25.6	92	—14	46.0	106

DETROIT, MICHIGAN.

TABLE B.—Amount of rain and melted snow for months, seasons, and years, in United States inches and decimals.

Year.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Spring.	Summer.	Autumn.	Winter.	Year.
1859	0.47	1.02	3.18	1.61	0.94	....	....	....	....	....	....	1.63	5.73	....	....	....	....
1860	0.94	2.64	0.83	3.27	1.99	2.71	5.15	1.56	2.79	1.92	1.80	2.43	6.09	9.42	6.51	5.21	28.03
1861	1.55	1.97	5.41	3.58	1.98	3.44	2.86	3.53	7.00	3.44	1.75	1.89	10.97	9.83	12.19	5.95	38.40
1862	2.63	0.63	4.78	2.53	3.05	3.21	1.92	3.42	2.48	2.82	2.20	1.85	10.28	8.55	7.50	5.15	31.44
1863	2.01	2.08	1.82	1.40	2.67	2.50	4.20	4.22	1.12	3.11	2.91	2.33	5.89	10.92	7.14	5.94	30.37
1864	1.43	0.84	1.07	3.54	3.37	2.24	1.68	2.89	2.96	1.44	2.73	1.69	7.98	6.81	7.13	4.60	25.88
1865	0.33	0.86	2.08	1.92	1.40	1.18	3.37	2.46	2.52	3.52	0.05	1.41	5.40	7.01	6.09	2.88	21.10
1866	0.81	1.55	2.53	1.45	3.24	5.69	2.94	2.51	4.34	2.00	2.66	2.00	7.22	11.14	9.00	3.77	31.72

MONROE CITY, MICHIGAN.—ALTITUDE 567 FEET.

TABLE B.—Maximum, minimum, and mean barometrical pressure for each month from the year 1859 to 1866 inclusive, reduced to 32° Fahr. + 28 inches.

Year.	January.			February.			March.			April.			May.			June.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1859	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
1860	2.059	0.936	1.454	1.903	0.646	1.411	1.684	0.845	1.369	1.990	0.648	1.357	1.713	0.987	1.317	1.658	0.704	1.338
1861	1.980	0.690	1.443	1.814	0.785	1.345	1.947	0.870	1.407	1.752	0.852	1.303	1.759	0.711	1.335	1.574	1.160	1.370
1862	1.992	0.886	1.466	1.881	0.703	1.419	1.620	0.771	1.259	1.810	0.910	1.453	1.755	0.989	1.383	1.747	1.005	1.373
1863	1.998	0.676	1.387	2.027	0.865	1.508	1.810	0.922	1.387	1.798	0.703	1.392	1.695	0.820	1.347	1.687	0.940	1.353
1864	1.885	0.928	1.404	1.930	0.732	1.298	1.681	0.628	1.258	1.696	0.993	1.313	1.574	1.021	1.261	1.715	0.929	1.438
1865	1.901	0.998	1.407	1.949	0.924	1.455	1.750	0.643	1.329	1.838	0.862	1.383	1.687	0.912	1.321	1.510	1.077	1.375
1866	2.641	0.881	1.518	2.039	1.013	1.489	1.853	0.830	1.453	1.700	0.839	1.356	1.675	0.600	1.259	1.656	0.849	1.290

MONROE CITY, MICHIGAN.—ALTITUDE 567 FEET.

TABLE B.—Maximum, minimum, and mean barometrical pressure for each month from the year 1859 to 1866 inclusive, reduced to 32° Fahr. + 28 inches.

Year.	July.			August.			September.			October.			November.			December.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1859	1.854	1.136	1.451	1.634	1.251	1.397	1.855	1.027	1.432	1.770	0.950	1.471	2.004	0.995	1.463	2.008	0.905	1.472
1860	1.664	0.922	1.356	1.674	1.069	1.385	1.834	1.131	1.494	1.733	0.813	1.441	1.661	0.724	1.324	2.034	0.820	1.491
1861	1.625	1.009	1.371	1.652	1.151	1.436	1.864	1.055	1.435	1.821	0.791	1.407	1.753	0.856	1.302	2.003	1.052	1.562
1862	1.690	1.087	1.347	1.717	1.141	1.427	1.767	1.049	1.485	1.841	1.118	1.456	2.059	1.119	1.512	2.101	0.955	1.460
1863	1.681	1.030	1.369	1.720	1.064	1.428	1.881	1.022	1.482	1.928	0.956	1.447	1.848	0.963	1.381	1.972	0.663	1.446
1864	1.605	1.150	1.412	1.585	0.962	1.306	1.616	1.048	1.365	1.651	0.970	1.314	1.838	0.692	1.348	2.032	0.735	1.301
1865	1.681	0.983	1.394	1.642	1.170	1.448	1.682	1.040	1.453	1.742	0.757	1.388	1.966	0.732	1.447	1.845	0.758	1.419
1866	1.604	1.078	1.374	1.700	0.975	1.341	1.664	1.012	1.394	1.875	1.033	1.464	2.059	0.862	1.393	1.943	0.661	1.390

MONROE CITY, MICHIGAN. + 28 INCHES.

TABLE B.—Maximum, minimum, and mean barometrical pressure reduced to 32° Fahr. for seasons.

Year.	Spring.			Summer.			Autumn.			Winter.			Year.			Range.
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	
1859	....	....	....	....	....	....	2.004	0.895	1.445	....	....	....	....	....	....	....
1860	1.990	0.648	1.349	1.674	0.704	1.359	1.634	0.724	1.419	2.059	0.646	1.446	2.059	0.646	1.395	1.413
1861	1.947	0.711	1.348	1.652	1.009	1.392	1.864	0.791	1.381	2.034	0.690	1.426	2.003	0.690	1.392	1.313
1862	1.810	0.771	1.365	1.747	1.005	1.382	2.059	1.049	1.484	2.003	0.703	1.482	2.101	0.703	1.420	1.398
1863	1.810	0.703	1.375	1.720	0.940	1.383	1.928	0.956	1.437	2.101	0.676	1.452	2.027	0.663	1.410	1.364
1864	1.696	0.628	1.277	1.715	0.929	1.385	1.838	0.692	1.342	1.972	0.663	1.383	2.032	0.628	1.335	1.404
1865	1.838	0.643	1.344	1.681	0.983	1.406	1.966	0.732	1.429	2.032	0.735	1.388	1.966	0.643	1.401	1.323
1866	1.853	0.600	1.356	1.700	0.849	1.335	2.059	0.862	1.417	2.641	0.758	1.475	2.641	0.600	1.393	2.041

MONROE CITY, MICHIGAN.

TABLE B.—Maximum, minimum, and mean temperature for each month from the year 1859 to 1866 inclusive.

Year.	January.			February.			March.			April.			May.			June.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1859																		
1860	44	—15	26.1	50	—5	26.8	66	20	39.4	65	22	44.9	82	37	60.7	82	53	68.3
1861	43	1	25.0	55	—12	30.1	64	9	33.4	74	30	46.6	79	31	53.5	87	44	68.6
1862	48	5	25.8	49	—8	25.2	51	8	32.4	64	31	45.0	82	38	57.8	83	48	65.2
1863	52	—7	31.3	54	—1	28.4	65	6	32.2	76	19	45.7	89	33	61.9	97	38	67.6
1864	73	—16	25.9	52	—8	30.8	63	4	33.1	61	28	45.1	92	36	61.7	101	38	70.0
1865	49	—4.5	23.3	53	7	28.8	75	—7.5	38.8	76.5	24	48.7	91	31.5	60.0	96	52	75.2
1866	52	—7	24.3	61	—19	25.8	62	7	31.8	78	22	50.5	85	29	57.1	94	47	69.3

Year.	July.			August.			September.			October.			November.			December.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1859	90	57	73.7	85	46	72.0	73	45	60.9	74	28	47.7	62	21	40.2	53	—13	22.3
1860	83	53	71.1	89	51	71.0	82	39	60.3	73	32	52.2	58	5	37.8	40	—1	25.6
1861	88	47	70.1	96	54	72.3	80	40	64.4	72	32	54.9	57	21	39.5	55	13	34.3
1862	93	55	74.0	89	51	74.9	84	44	66.1	80	24	53.2	66	25	41.7	59	5	34.3
1863	95	41	72.0	95	34	71.3	89	27	61.0	78	25	47.4	66	13	41.8	55	6	32.5
1864	100	47	76.5	99	44	73.6	87	36	62.5	72	25	48.7	71	12	39.2	57	—8	27.1
1865	98	46	71.6	97	40	71.4	93	43	70.8	86	24	50.5	70	19	39.6	54	—3	29.1
1866	103	52	78.9	92	38	69.5	92	33	61.7	85	31	55.4	67	21	40.9	53	3.5	27.7

MONROE CITY, MICHIGAN.

TABLE B.—Maximum, minimum, and mean temperature for seasons and years from 1859 to 1866 inclusive.

Year.	Spring.			Summer.			Autumn.			Winter.			Year.			Range.
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	
1859	......	......	......	......	......	......	74	21	49.6	......	......	......	......	......	......	......
1860	82	20	48.3	89	51	70.1	82	5	50.1	50	—15	25.1	89	—15	48.7	104
1861	79	9	44.5	96	44	71.3	80	21	52.9	55	—12	26.9	96	—12	49.3	108
1862	82	8	45.1	93	48	71.4	84	25	53.7	55	— 8	28.4	93	— 8	49.6	101
1863	89	6	46.6	97	34	70.3	89	13	50.1	59	— 7	31.3	97	— 7	49.4	104
1864	92	4	46.6	101	38	73.4	87	12	50.1	73	—16	29.7	101	—16	49.5	117
1865	91	75	49.2	98	40	72.7	93	19	53.6	57	— 8	26.4	98	— 7	50.6	105
1866	85	7	46.5	103	38	72.6	92	21	52.7	61	—19	26.4	103	—19	49.4	122

MONROE CITY, MICHIGAN.

TABLE B.—Amount of rain and melted snow for months, seasons, and years, in United States inches and decimals.

Year.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Spring.	Summer.	Autumn.	Winter.	Year.
1859	......	......	......	......	......	......	0.66	4.14	2.10	1.81	2.42	2.33	......	......	6.33	......	......
1860	0.93	2.40	0.65	3.79	2.65	1.86	6.39	1.69	2.43	1.94	1.29	1.73	7.09	9.94	5.66	5.66	27.75
1861	1.00	1.00	4.15	3.39	2.02	4.14	3.80	3.33	5.48	2.79	2.72	1.15	9.56	11.27	10.99	3.73	34.97
1862	2.69	1.53	4.38	2.89	3.54	2.28	1.90	2.61	2.61	3.09	2.05	3.16	10.81	6.79	7.75	5.37	32.73
1863	2.81	1.98	3.13	2.12	1.55	1.01	2.61	6.23	1.45	2.91	2.57	2.20	6.80	9.85	6.93	7.95	30.57
1864	1.42	0.75	1.43	3.72	1.98	1.54	3.10	3.35	4.19	1.75	3.78	2.17	7.13	7.99	9.72	4.37	29.18
1865	0.47	0.96	2.23	1.84	2.38	2.75	5.33	3.56	7.59	2.35	0.39	3.51	6.45	11.64	10.33	3.60	33.36
1866	1.92	1.74	3.06	0.80	3.39	4.51	2.27	1.53	5.11	2.34	2.51	1.96	7.25	8.31	9.96	7.17	31.14

CLEVELAND, OHIO.—ALTITUDE 645 FEET.

TABLE B.—Maximum, minimum, and mean barometrical pressure for each month from the year 1859 to 1866 inclusive, reduced to 32° Fahr., + 28 inches.

Year.	January.			February.			March.			April.			May.			June.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1859	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	1.685	1.030	1.344
1860	1.954	0.950	1.371	1.788	0.700	1.384	1.622	0.817	1.286	1.894	0.547	1.282	1.614	0.927	1.248	1.571	0.628	1.261
1861	1.892	0.731	1.354	1.761	0.781	1.279	1.718	0.770	1.331	1.670	0.735	1.228	1.654	0.640	1.245	1.496	0.969	1.284
1862	1.858	0.866	1.370	1.794	0.685	1.326	1.506	0.631	1.158	1.747	0.776	1.378	1.610	0.973	1.303	1.703	0.930	1.289
1863	1.961	0.797	1.333	1.936	0.743	1.428	1.726	0.864	1.303	1.692	0.629	1.318	1.641	0.782	1.276	1.574	0.854	1.287
1864	1.821	0.838	1.341	1.665	0.695	1.223	1.647	0.535	1.187	1.593	0.908	1.249	1.523	0.929	1.192	1.645	0.867	1.367
1865	1.894	0.849	1.332	1.876	0.845	1.374	1.675	0.594	1.268	1.796	0.866	1.332	1.820	0.872	1.255	1.532	1.020	1.328
1866	2.509	0.773	1.461	1.969	0.937	1.422	1.753	0.840	1.371	1.630	0.605	1.307	1.485	0.539	1.183	1.557	0.751	1.239

Year.	July.			August.			September.			October.			November.			December.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1859	1.776	1.068	1.381	1.499	1.087	1.318	1.776	0.917	1.359	1.659	0.863	1.374	1.875	0.820	1.386	1.838	0.838	1.375
1860	1.588	0.905	1.284	1.574	1.022	1.303	1.764	1.060	1.404	1.617	0.918	1.318	1.567	0.512	1.234	1.908	0.908	1.399
1861	1.526	0.990	1.288	1.556	0.995	1.337	1.757	0.903	1.346	1.718	0.773	1.329	1.681	0.713	1.205	1.925	0.932	1.470
1862	1.663	0.907	1.276	1.646	1.070	1.360	1.602	0.937	1.393	1.682	0.913	1.367	1.942	0.896	1.343	2.016	1.031	1.409
1863	1.587	1.070	1.304	1.699	1.033	1.373	1.797	1.058	1.416	1.843	0.916	1.382	1.782	0.975	1.320	1.910	0.621	1.385
1864	1.531	1.075	1.342	1.554	0.875	1.260	1.584	0.950	1.285	1.512	0.896	1.240	1.795	0.586	1.289	1.993	0.528	1.231
1865	1.607	0.928	1.315	1.590	1.070	1.380	1.618	1.057	1.404	1.712	0.682	1.316	1.873	0.680	1.385	1.907	0.879	1.362
1866	1.581	1.018	1.335	1.635	0.932	1.300	1.664	1.000	1.342	1.778	1.111	1.424	2.022	0.808	1.364	1.866	0.615	1.350

CLEVELAND, OHIO. + 28 INCHES.

TABLE B.—Maximum, minimum, and mean barometrical pressure reduced to 32° Fahr. for seasons.

Year.	Spring.			Summer.			Autumn.			Winter.			Year.			Range.
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	
1859				1.776	1.030	1.347	1.875	0.863	1.373							
1860	1.894	0.547	1.272	1.588	0.628	1.282	1.764	0.512	1.328	1.954	0.700	1.377	1.954	0.512	1.317	1.442
1861	1.718	0.640	1.268	1.556	0.969	1.303	1.757	0.713	1.293	1.908	0.721	1.344	1.925	0.640	1.308	1.285
1862	1.747	0.631	1.279	1.703	0.907	1.308	1.942	0.896	1.367	1.925	0.685	1.389	2.016	0.631	1.331	1.385
1863	1.726	0.629	1.299	1.699	0.854	1.321	1.843	0.916	1.373	2.016	0.743	1.390	1.961	0.621	1.343	1.340
1864	1.647	0.535	1.209	1.645	0.867	1.323	1.795	0.586	1.271	1.910	0.621	1.316	1.993	0.528	1.267	1.465
1865	1.820	0.594	1.285	1.607	0.928	1.341	1.873	0.680	1.368	1.993	0.528	1.312	1.907	0.594	1.338	1.413
1866	1.753	0.539	1.287	1.635	0.751	1.291	2.022	0.808	1.377	2.509	0.773	1.415	2.509	0.539	1.341	1.970

CLEVELAND, OHIO.

TABLE B.—Maximum, minimum, and mean temperature for each month from the year 1859 to 1866 inclusive.

Year.	January.			February.			March.			April.			May.			June.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1859																91	51	
1860	55	—11	28.3	68	5	29.9	70	20	41.3	75	25	46.8	85	35	63.3	83	53	67.9
1861	46	— 2	27.1	71	—12	34.1	75	9	36.5	83	26	49.0	83	31	53.4	91	39	68.2
1862	53	4	27.3	50	6	26.6	67	9	33.0	83	27	46.9	86	33	56.7	87	42	63.4
1863	55	3.	32.0	52	5	29.3	64	11	32.2	76	17	43.4	88	37	60.1	91	43	66.2
1864	66	—14	26.6	60	— 8	30.3	62	12	34.7	63	30	45.4	91	32	59.5	94	42	67.7
1865	43	— 2	21.0	50	—10	26.8	76	9	39.5	79	30	51.0	91	32	59.4	91	52	74.4
1866	62	2	26.3	59	—14	27.9	67	7	33.4	84	23	51.4	89	35	56.1	93	48	68.7

CLEVELAND, OHIO.

TABLE B.—Maximum, minimum, and mean temperature for each month from the year 1859 to 1866 inclusive.

Year.	July.			August.			September.			October.			November.			December.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1859	91	50	73.9	85	50	71.5	78	45	62.7	82	32	48.8	73	21	42.5	63	—9	24.6
1860	85	51	69.7	92	47	69.6	87	37	60.7	75	37	53.2	75	5	39.7	46	6	27.5
1861	92	49	70.4	92	50	70.8	87	42	63.9	81	30	54.5	59	21	40.2	68	10	37.0
1862	93	53	72.4	93	53	72.6	88	41	65.7	85	31	54.2	72	24	39.5	59	9	34.6
1863	88	48	70.9	93	43	72.1	86	35	61.8	74	30	49.9	70	13	42.2	58	8	33.8
1864	92	55	74.9	91	52	72.4	80	47	62.8	73	33	49.7	70	15	41.7	56	2	26.1
1865	90	50	69.5	85	48	70.1	86	50	70.8	76	32	52.4	74	20	43.1	62	1	32.7
1866	97	57	76.3	82	47	66.9	85	43	61.3	75	34	52.9	62	27	42.7	57	2	26.5

CLEVELAND, OHIO.

TABLE B.—Maximum, minimum, and mean temperature for seasons and years from 1859 to 1866 inclusive.

Year.	Spring.			Summer.			Autumn.			Winter.			Year.			Range.
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	
1859	......	......	......	91	50	......	82	21	51.3	......	......	......	......	......	......	......
1860	85	20	50.5	92	47	68.8	87	5	51.2	68	—11	27.6	92	5	49.8	87
1861	83	9	46.3	92	39	69.8	87	21	52.8	71	—12	29.6	92	—12	50.4	104
1862	86	9	45.5	93	42	69.5	88	24	53.2	68	4	30.3	93	4	49.4	89
1863	88	11	45.3	93	43	69.7	86	13	51.3	59	3	32.0	93	5	49.5	88
1864	91	12	46.5	94	42	71.7	80	15	51.4	66	—14	30.2	94	—14	49.5	108
1865	91	9	50.3	91	48	71.3	86	20	55.4	56	—10	25.3	91	—10	50.9	101
1866	89	7	47.0	97	47	70.6	85	27	52.3	62	—14	29.0	97	—14	49.2	111

CLEVELAND, OHIO.

TABLE B.—Amount of rain and melted snow for months, seasons, and years, in United States inches and decimals.

Years.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Spring.	Summer.	Autumn.	Winter.	Year.
1859	......	......	......	......	......	......	1.25	3.30	3.34	1.43	4.29	5.12	......	......	9.06	......	......
1860	2.24	2.03	1.24	6.47	2.94	1.34	4.59	4.97	3.32	3.06	4.05	2.18	10.65	10.90	10.43	9.39	38.43
1861	2.36	1.17	3.34	4.23	3.56	1.77	1.84	3.60	3.40	3.98	4.83	1.64	11.13	7.21	12.21	5.71	36.72
1862	3.91	3.10	4.00	2.83	2.45	4.29	5.54	1.32	2.25	3.04	4.26	4.34	9.28	11.15	9.55	8.65	41.33
1863	5.44	3.35	3.20	1.50	2.97	2.66	2.02	2.32	3.13	3.13	4.36	2.52	7.67	7.00	10.62	13.13	36.60
1864	2.62	1.30	2.13	2.26	3.92	0.70	1.97	5.37	5.40	5.40	3.84	2.96	8.31	8.04	11.22	6.44	34.45
1865	2.01	1.82	3.17	3.03	2.44	2.74	3.63	1.47	5.46	2.35	0.76	3.89	8.64	9.84	8.57	6.79	32.77
1866	2.08	2.29	3.76	2.78	3.82	10.30	3.66	3.68	6.70	3.40	2.70	3.22	10.36	17.64	12.80	8.26	48.39

BUFFALO, NEW YORK.—ALTITUDE 585 FEET.

TABLE B.—Maximum, minimum, and mean barometrical pressure for each month from the year 1859 to 1866 inclusive, reduced to 32° Fahr. + 28 inches.

Year.	January.			February.			March.			April.			May.			June.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1859	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
1860	1.924	1.001	1.398	1.879	0.596	1.417	1.715	0.923	1.308	2.007	0.680	1.347	1.647	0.999	1.346	1.747	0.679	1.302
1861	2.043	0.750	1.405	1.869	0.685	1.329	1.852	0.849	1.374	1.828	0.855	1.318	1.707	0.390	1.288	1.577	1.080	1.319
1862	1.882	0.775	1.436	1.778	0.678	1.364	1.553	0.664	1.223	1.825	0.825	1.465	1.650	1.031	1.358	1.832	0.960	1.337
1863	2.117	0.654	1.361	2.146	0.827	1.520	1.871	0.870	1.371	1.767	0.536	1.389	1.680	0.797	1.345	1.556	0.813	1.334
1864	1.807	0.606	1.317	1.889	0.797	1.222	1.695	0.604	1.230	1.665	1.006	1.289	1.482	0.938	1.201	1.646	0.757	1.379
1865	1.856	0.863	1.395	1.908	0.867	1.406	1.764	0.570	1.291	1.828	0.889	1.369	1.690	0.877	1.291	1.595	1.038	1.362
1866	2.526	0.924	1.488	2.053	0.866	1.422	1.886	0.806	1.360	1.656	0.543	1.321	1.557	0.600	1.198	1.525	0.709	1.948

BUFFALO, NEW YORK.—ALTITUDE 585 FEET.

TABLE B.—Maximum, minimum, and mean barometrical pressure for each month from the year 1859 to 1866 inclusive, reduced to 32° Fahr. + 28 inches.

Year.	July.			August.			September.			October.			November.			December.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1859	1.875	1.047	1.428	1.665	1.077	1.405	1.824	0.922	1.428	1.767	1.088	1.419	1.956	0.853	1.483	2.101	0.945	1.431
1860	1.606	1.020	1.338	1.618	1.092	1.349	1.862	1.059	1.441	1.699	0.928	1.414	1.728	0.653	1.299	1.965	0.673	1.453
1861	1.582	1.054	1.320	1.623	1.192	1.406	1.840	0.892	1.390	1.786	0.792	1.378	1.735	0.843	1.263	1.937	0.943	1.495
1862	1.731	0.990	1.319	1.741	1.141	1.400	1.742	0.872	1.469	1.735	0.965	1.393	2.145	0.884	1.401	2.117	0.886	1.422
1863	1.657	1.153	1.362	1.822	1.135	1.425	1.851	1.010	1.468	1.902	1.020	1.426	1.822	0.878	1.327	1.998	0.544	1.432
1864	1.566	1.098	1.363	1.567	0.888	1.288	1.683	0.996	1.327	1.577	0.742	1.238	1.845	0.429	1.302	1.993	0.545	1.232
1865	1.681	1.032	1.344	1.663	1.015	1.398	1.704	1.168	1.437	1.758	0.578	1.323	2.007	0.886	1.389	1.761	0.842	1.774
1866	1.620	1.085	1.336	1.635	1.065	1.288	1.663	0.912	1.357	1.911	0.958	1.437	2.019	0.638	1.347	1.982	0.493	1.345

BUFFALO, NEW YORK. + 28 INCHES.

TABLE B.—Maximum, minimum, and mean barometrical pressure reduced to 32° Fahr., for seasons.

Year.	Spring.			Summer.			Autumn.			Winter.			Year.			Range.
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	
1859	....	....	....	....	....	....	1.956	0.853	1.443	....	....	....	....	....	....	....
1860	2.007	0.680	1.333	1.747	0.679	1.329	1.862	0.653	1.385	2.101	0.596	1.415	2.007	0.653	1.367	1.354
1861	1.852	0.390	1.327	1.623	1.054	1.348	1.840	0.792	1.343	2.043	0.673	1.396	2.043	0.390	1.357	1.653
1862	1.825	0.664	1.349	1.832	0.960	1.352	2.145	0.872	1.421	1.937	0.678	1.432	2.145	0.664	1.382	1.481
1863	1.871	0.536	1.368	1.822	0.813	1.374	1.902	0.878	1.407	2.146	0.654	1.434	2.146	0.536	1.397	1.610
1864	1.695	0.604	1.240	1.567	0.757	1.343	1.845	0.429	1.289	1.998	0.544	1.324	1.993	0.429	1.292	1.564
1865	1.828	0.570	1.317	1.681	1.015	1.368	2.007	0.578	1.383	1.993	0.545	1.321	2.007	0.570	1.379	1.437
1866	1.686	0.443	1.293	1.635	0.709	1.291	2.019	0.638	1.380	2.526	0.842	1.428	2.526	0.493	1.346	1.033

BUFFALO, NEW YORK.

TABLE B.—Maximum, minimum, and mean temperature for each month from the year 1859 to 1866 inclusive.

Year.	January.			February.			March.			April.			May.			June.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1859																		
1860	47	5	26.3	57	— 3	26.0	67	17	35.9	68	25	42.4	84	37	59.7	83	51	65.2
1861	42	—13	23.8	55	—22	28.6	58	— 2	30.6	73	24	44.9	79	26	51.7	81	43	65.0
1862	48	— 1	25.5	41	5	25.3	50	14	31.7	74	25	44.1	85	32	55.4	86	28	61.8
1863	55	3	31.5	49	0	26.4	51	4	28.8	72	12	43.6	86	32	55.8	69	39	62.8
1864	55	— 9	25.2	53	— 6	26.8	56	5	31.0	68	28	42.9	76	31	55.7	96	37	64.8
1865	43	—13	20.2	48	—12	22.7	65	3	35.9	70	25	44.3	78	31	54.2	90	47	68.7
1866	60	— 7	21.6	63	— 6	24.6	61	5	29.2	77	25	45.8	79	30	49.3	84	39	63.6

Year.	July.			August.			September.			October.			November.			December.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1859	88	49	70.6	87	52	70.4	75	36	60.0	69	26	46.8	63	27	41.6	50	2	23.0
1860	89	54	67.9	86	43	67.9	81	28	58.1	72	29	50.8	73	9	39.3	40	— 4	25.8
1861	84	48	68.1	87	49	69.1	78	43	61.9	73	28	52.2	55	25	38.7	61	8	34.2
1862	83	45	69.4	92	42	70.5	89	36	63.8	80	30	52.0	64	21	39.0	56	3	32.8
1863	91	51	70.5	94	39	70.3	85	31	59.6	79	24	48.5	63	19	41.8	51	3	30.2
1864	93	50	72.3	86	45	67.9	77	43	59.9	69	31	47.5	69	19	39.1	54	2	28.1
1865	85	47	66.7	86	40	68.1	90	41	68.1	69	24	47.4	66	23	39.9	57	8	31.3
1866	84	49	71.3	78	46	63.7	82	38	58.5	77	31	52.4	58	23	39.8	57	— 9	25.9

BUFFALO, NEW YORK.

TABLE B.—Maximum, minimum, and mean temperature for seasons and years from 1859 to 1866 inclusive.

Year.	Spring.			Summer.			Autumn.			Winter.			Year.			Range.
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	
1859							75	27	49.4							
1860	84	17	46.0	89	43	66.9	81	9	49.4	57	—3	25.1	89	—4	47.1	93
1861	79	—2	42.4	87	43	64.4	78	25	51.0	55	—22	26.1	87	—22	47.4	109
1862	85	14	43.7	92	28	67.2	89	21	51.6	61	—1	28.3	92	—1	47.6	93
1863	86	4	42.8	94	39	67.9	85	19	50.0	56	0	30.2	94	0	47.5	94
1864	76	5	43.2	96	37	68.3	77	19	48.8	55	—9	27.4	96	—9	46.8	105
1865	78	3	44.8	90	40	67.8	90	23	51.8	54	—13	23.7	90	—13	47.4	103
1866	79	5	41.3	84	39	66.2	88	23	50.2	63	7	25.8	84	—9	45.5	93

BUFFALO, NEW YORK.

TABLE B.—Amount of rain and melted snow for months, seasons, and years, in United States inches and decimals.

Year.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Spring.	Summer.	Autumn.	Winter.	Year.
1859							0.85	3.52	1.74	1.58	1.21	3.70			4.53		
1860	1.52	0.81	1.01	1.02	2.59	2.09	2.46	3.00	4.07	3.25	4.20	1.69	4.62	7.54	11.52	6.03	27.70
1861	1.55	2.37	3.30	3.18	3.12	1.22	5.00	2.87	5.08	3.60	2.20	1.55	9.60	9.09	10.88	5.61	35.04
1862	2.14	2.56	5.58	1.74	1.56	2.88	2.98	3.08	4.35	2.87	2.78	3.16	8.89	8.94	10.00	6.25	35.69
1863	2.38	2.34	2.22	1.90	1.66	1.50	4.10	2.98	1.64	3.35	2.38	1.16	5.78	8.58	7.37	7.88	27.91
1864	3.32	1.36	1.22	3.00	5.48	1.14	1.58	6.78	2.98	4.74	2.78	4.00	9.70	9.50	10.50	5.84	38.38
1865	3.17	2.02	4.60	3.90	2.94	2.56	1.48	0.82	3.52	3.16	0.66	3.04	11.44	4.86	7.34	9.19	31.87
1866	1.38	1.44	1.66	2.26	4.48	0.48	1.88	4.80	6.94	2.16	3.22	4.22	8.40	7.16	12.32	5.85	34.92

FORT NIAGARA, NEW-YORK.—ALTITUDE 262 FEET.

TABLE B.—Maximum, minimum, and mean barometrical pressure for each month from the year 1859 to 1866 inclusive, reduced to 32° Fahr. + 28 inches.

Year.	January.			February.			March.			April.			May.			June.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1859	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
1860	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
1861	2.466	1.123	1.763	2.273	1.068	1.668	2.310	1.210	1.744	2.322	1.237	1.679	2.121	0.936	1.645	1.904	1.353	1.664
1862	2.451	1.143	1.855	2.275	1.223	1.812	1.934	0.905	1.625	2.244	1.250	1.834	2.022	1.389	1.688	2.224	1.309	1.677
1863	2.445	0.958	1.740	2.315	1.145	1.834	3.490	1.291	1.759	2.172	1.328	1.727	1.965	1.037	1.660	1.967	1.104	1.654
1864	2.166	1.110	1.707	2.243	1.140	1.632	2.202	0.963	1.671	2.059	1.406	1.711	1.990	1.274	1.609	2.069	1.254	1.759
1865	2.250	1.195	1.722	2.283	1.218	1.796	2.171	0.828	1.659	2.208	1.116	1.744	2.144	1.198	1.692	2.041	1.400	1.758
1866	2.957	1.256	1.881	2.413	1.211	1.806	2.200	1.198	1.761	2.068	0.980	1.741	1.909	1.043	1.577	2.057	1.145	1.654

Year.	July.			August.			September.			October.			November.			December.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1859	2.064	1.410	......	1.892	1.443	......	2.210	1.212	......	......	......	......	......	......	......	......	......	......
1860	1.998	1.403	1.657	1.999	1.421	1.721	2.257	1.369	1.800	2.132	1.186	1.779	2.015	0.963	1.629	2.521	1.068	1.764
1861	1.984	1.308	1.653	2.002	1.400	1.744	2.297	1.118	1.739	2.203	1.224	1.727	2.000	1.151	1.604	2.325	1.236	1.852
1862	2.052	1.318	1.670	2.183	1.422	1.753	2.067	1.236	1.804	2.107	1.117	1.737	2.617	1.208	1.744	2.502	1.246	1.757
1863	1.993	1.393	1.687	2.074	1.451	1.745	2.284	1.338	1.826	2.333	1.385	1.819	2.368	1.308	1.714	2.452	0.965	1.823
1864	1.997	1.435	1.745	1.975	1.248	1.667	2.039	1.356	1.710	2.020	1.148	1.642	2.236	0.876	1.714	2.373	1.043	1.628
1865	2.073	1.306	1.715	2.016	1.388	1.750	2.204	1.468	1.764	2.238	0.880	1.708	2.453	1.200	1.794	2.270	1.363	1.769
1866	2.088	1.380	1.773	2.061	1.435	1.721	2.130	1.382	1.824	2.355	1.375	1.901	2.499	1.035	1.848	2.486	0.978	1.765

FORT NIAGARA, NEW YORK. + 28 INCHES:

TABLE B.—Maximum, minimum, and mean barometrical pressure reduced to 32° Fahr., for seasons.

Year.	Spring.			Summer.			Autumn.			Winter.			Year.			Range.
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	
1859	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
1860	......	......	......	......	......	......	2.257	0.963	1.736	......	......	......	......	......	......	......
1861	2.322	0.936	1.688	2.002	1.308	1.687	2.297	1.118	1.690	2.521	1.068	1.732	2.466	0.936	1.707	1.530
1862	2.244	0.905	1.715	2.224	1.309	1.700	2.617	1.117	1.762	2.451	1.143	1.840	2.617	0.905	1.746	1.712
1863	2.400	1.037	1.715	2.074	1.104	1.695	2.333	1.308	1.786	2.502	0.958	1.777	2.452	0.958	1.749	1.494
1864	2.202	0.963	1.664	2.069	1.248	1.724	2.236	1.148	1.629	2.452	0.965	1.656	2.373	0.963	1.683	1.310
1865	2.208	1.116	1.698	2.073	1.306	1.741	2.453	0.880	1.755	2.373	1.043	1.715	2.453	0.880	1.739	1.573
1866	2.200	0.980	1.693	2.088	1.145	1.716	2.499	1.035	1.858	2.957	1.211	1.819	2.957	0.978	1.771	1.979

FORT NIAGARA, NEW YORK.

TABLE B.—Maximum, minimum, and mean temperature for each month from the year 1859 to 1866 inclusive.

Year.	January.			February.			March.			April.			May.			June.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1859	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
1860	53	2	27.8	60	4	26.2	63	18	36.0	56	23	39.2	78	34	53.8	84	51	63.8
1861	40	—1	23.1	54	—15	28.7	54	3	29.4	74	25	41.4	73	31	49.0	83	46	63.2
1862	47	8	25.6	42	8	25.0	46	15	31.7	75	19	40.6	81	18	53.2	80	......	60.6
1863	56	6	31.4	50	6	26.9	49	10	28.4	71	14	40.8	82	34	53.8	82	45	61.5
1864	56	—9	25.3	53	— 3	28.4	51	8	31.3	62	29	41.0	75	35	53.2	90	40	65.0
1865	43	1	21.1	45	2	24.2	55	7	33.7	67	26	43.2	79	31	52.1	88	49	67.9
1866	48	0	33.1	52	3	25.6	48	8	28.7	74	27	43.3	80	32	48.3	90	42	62.0

FORT NIAGARA, NEW YORK.

TABLE B.—Maximum, minimum, and mean temperature for each month from the year 1859 to 1866 inclusive.

Year.	July.			August.			September.			October.			November.			December.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1859	88	53	69.5	82	50	69.7	74	41	59.0	73	25	46.8	65	25	39.9	60	— 8	22.5
1860	80	59	67.3	88	55	67.3	76	33	58.1	69	33	49.8	70	14	39.5	43	3	25.9
1861	88	53	68.4	88	51	67.8	82	48	61.8	71	32	51.6	54	25	38.9	63	9	34.8
1862	90	....	69.8	89	52	71.2	85	45	64.0	82	33	52.4	65	20	38.6	58	7	31.9
1863	83	54	69.1	88	48	69.9	85	40	59.2	68	27	48.3	66	22	40.2	55	14	29.8
1864	91	55	72.2	89	46	71.1	77	43	60.1	67	34	47.4	62	24	40.1	45	7	28.2
1865	84	51	67.6	89	52	67.6	86	42	65.0	70	31	48.5	67	25	41.4	57	8	31.3
1866	93	52	73.0	76	47	64.3	84	39	58.1	73	34	53.4	58	24	40.4	54	— 3	26.2

FORT NIAGARA, NEW YORK.

TABLE B.—Maximum, minimum, and mean temperature for seasons and years from 1859 to 1866 inclusive.

Year.	Spring.			Summer.			Autumn.			Winter.			Year.			Range.
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	
1859	....	....	....	....	....	....	74	25	48.5	....	....	....	....	....	....	....
1860	78	18	43.0	88	51	66.1	76	14	49.1	60	— 8	25.5	88	2	46.2	86
1861	73	3	39.9	88	46	66.5	82	25	50.8	54	—15	25.9	88	—15	46.5	103
1862	81	15	41.8	90	52	67.2	85	20	51.6	63	8	28.5	90	7	47.0	83
1863	82	10	41.0	88	45	66.8	85	22	49.2	58	6	29.7	88	6	46.5	82
1864	75	8	41.8	91	40	69.4	77	24	49.2	56	— 9	27.8	91	— 9	46.9	100
1865	79	7	43.0	89	43	67.7	86	25	51.6	45	1	24.5	89	1	47.0	88
1866	80	8	40.1	93	42	66.4	84	24	50.6	57	0	30.0	93	— 3	46.4	96

FORT NIAGARA, NEW YORK.

TABLE B.—Amount of rain and melted snow for months, seasons, and years, in United States inches and decimals.

Year.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Spring.	Summer.	Autumn.	Winter.	Year.
1859	....	....	....	....	....	....	1.28	2.68	2.20	1.46	3.11	3.93	....	....	6.77	....	....
1860	1.69	2.51	1.77	1.26	1.56	1.61	3.76	3.35	1.59	1.79	3.98	3.58	4.59	8.72	7.36	8.13	28.45
1861	2.82	3.26	3.00	1.30	3.32	2.02	2.86	1.96	4.30	3.14	4.49	1.46	7.62	6.84	11.93	9.66	33.93
1862	2.14	1.91	4.14	1.18	1.14	2.23	2.28	2.35	1.94	3.66	1.84	1.92	6.46	6.86	7.44	5.51	26.73
1863	3.08	1.17	2.08	1.82	2.59	0.76	3.88	1.74	1.78	2.20	2.16	2.46	6.49	6.38	6.14	6.17	25.72
1864	2.75	0.88	2.12	3.00	4.12	0.28	3.46	3.16	1.48	5.25	1.80	2.08	5.16	7.99	5.90	6.09	24.88
1865	1.62	1.38	2.94	2.82	2.94	1.68	1.52	1.18	2.78	3.36	0.95	1.94	8.70	4.38	7.09	5.08	24.41
1866	1.03	2.20	1.90	2.22	3.06	2.05	4.53	3.32	4.56	1.12	3.38	2.12	7.18	9.90	9.06	4.47	31.49

CHARLOTTE, NEW YORK.—ALTITUDE 273 FEET.

TABLE B.—Maximum, minimum, and mean barometrical pressure for each month from the year 1859 to 1866 inclusive, reduced to 32° Fahr. + 28 inches.

Year.	January.			February.			March.			April.			May.			June.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1859	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
1860	2.205	1.263	1.707	2.155	0.956	1.740	2.085	1.133	1.577	2.355	1.079	1.694	1.946	1.138	1.637	1.957	0.970	1.584
1861	2.462	1.093	1.753	2.231	0.930	1.655	2.263	1.196	1.709	2.192	1.172	1.648	2.069	0.679	1.611	1.894	1.255	1.624
1862	2.357	1.005	1.779	2.183	0.945	1.713	1.957	0.968	1.579	2.193	1.140	1.817	1.968	1.260	1.669	2.183	1.275	1.641
1863	2.524	1.108	1.748	2.582	1.187	1.877	2.311	1.225	1.734	2.115	0.795	1.722	1.977	1.073	1.675	1.921	1.086	1.650
1864	2.277	0.906	1.682	2.259	1.102	1.571	2.119	1.202	1.602	2.030	1.344	1.674	1.895	1.252	1.561	2.023	1.090	1.731
1865	2.277	1.183	1.695	2.304	1.157	1.790	2.176	0.867	1.668	2.389	1.162	1.734	2.103	1.178	1.654	1.954	1.373	1.732
1866	2.989	1.216	1.857	2.496	1.250	1.811	2.175	1.132	1.708	2.067	0.825	1.700	2.034	0.982	1.558	2.031	1.153	1.632

CHARLOTTE, NEW YORK.—ALTITUDE 273 FEET.

TABLE B.—Maximum, minimum, and mean barometrical pressure for each month from the year 1859 to 1866 inclusive, reduced to 32° Fahr. + 28 inches.

Year.	July.			August.			September.			October.			November.			December.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1859	2.202	1.280	1.723	1.896	1.373	1.674	2.121	1.147	1.727	2.088	1.370	1.698	2.327	1.029	1.785	2.451	1.275	1.775
1860	1.896	1.248	1.622	2.004	1.398	1.635	2.206	1.330	1.770	2.040	1.216	1.748	2.093	1.080	1.587	2.287	0.930	1.725
1861	1.903	1.367	1.625	1.947	1.431	1.727	2.180	1.283	1.714	2.165	1.102	1.702	2.038	1.165	1.589	2.298	1.249	1.792
1862	1.989	1.393	1.621	2.074	1.389	1.712	2.080	1.168	1.766	2.064	1.191	1.716	2.553	1.151	1.724	2.501	1.196	1.761
1863	1.998	1.473	1.688	2.133	1.433	1.750	2.218	1.295	1.819	2.338	1.354	1.798	2.359	1.169	1.675	2.378	0.905	1.858
1864	1.961	1.415	1.706	1.941	1.175	1.617	2.102	1.356	1.682	2.016	1.018	1.591	2.191	0.704	1.666	2.363	0.892	1.611
1865	2.128	1.356	1.699	2.062	1.382	1.762	2.116	1.585	1.801	2.125	0.767	1.681	2.419	1.160	1.756	2.156	1.263	1.768
1866	2.067	1.442	1.709	1.999	1.276	1.641	2.082	1.281	1.726	2.329	1.366	1.805	2.457	0.947	1.714	2.404	0.975	1.720

CHARLOTTE, NEW YORK. + 28 INCHES.

TABLE B.—Maximum, minimum, and mean barometrical pressure reduced to 32° Fahr. for seasons.

Year.	Spring.			Summer.			Autumn.			Winter.			Year.			Range.
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	
1859	....	....	....	....	....	....	2.327	1.029	1.736	....	....	....	....	....	....	....
1860	2.335	1.079	1.621	2.004	0.970	1.614	2.206	1.080	1.701	2.451	0.956	1.741	2.335	0.930	1.665	1.405
1861	2.263	0.679	1.656	1.947	1.255	1.659	2.180	1.102	1.668	2.462	0.930	1.711	2.462	0.679	1.679	1.783
1862	2.193	0.968	1.688	2.183	1.275	1.658	2.553	1.151	1.735	2.357	0.945	1.761	2.553	0.945	1.707	1.608
1863	2.311	0.795	1.710	2.133	1.086	1.696	2.359	1.169	1.764	2.582	1.108	1.795	2.562	0.795	1.749	1.787
1864	2.119	1.202	1.612	2.023	1.090	1.685	2.191	0.704	1.646	2.378	0.905	1.704	2.363	0.704	1.641	1.659
1865	2.329	0.867	1.685	2.128	1.356	1.731	2.419	1.160	1.746	2.363	0.892	1.699	2.419	0.867	1.738	1.652
1866	2.175	0.825	1.655	2.067	1.276	1.661	2.457	0.947	1.715	2.989	1.216	1.812	2.989	0.825	1.715	2.164

CHARLOTTE, NEW YORK.

TABLE B.—Maximum, minimum, and mean temperature for each month from the year 1859 to 1866 inclusive.

Year.	January.			February.			March.			April.			May.			June.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1859	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
1860	53	5	27.7	58	2	27.3	66	10	37.2	70	23	42.9	77	41	58.0	85	49	65.8
1861	41	— 5	23.5	53	—20	29.3	61	— 2	31.6	77	20	44.6	73	24	51.0	86	39	64.3
1862	50	1	26.0	42	0	25.3	46	9	31.8	75	18	43.3	84	27	56.0	84	34	62.6
1863	56	— 5	31.9	47	—14	27.1	47	— 3	29.6	74	7	43.1	84	27	57.6	85	37	63.9
1864	64	—15	27.7	45	—12	29.6	50	2	33.1	68	21	43.4	80	26	57.4	93	32	67.3
1865	42	— 6	22.2	47	— 9	25.4	65	— 3	37.8	75	17	47.0	84	23	57.0	93	40	70.4
1866	52	—14	23.3	57	—12	27.1	59	0	30.7	77	16	48.6	84	24	51.2	93	32	66.4

CHARLOTTE, NEW YORK.

TABLE B.—Maximum, minimum, and mean temperature for each month from the year 1859 to 1866 inclusive.

Year.	July.			August.			September.			October.			November.			December.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1859	90	51	69.3	85	51	69.0	77	41	59.3	76	27	46.9	66	27	41.4	63	— 8	23.0
1860	83	41	66.8	92	43	68.1	79	30	58.5	67	26	50.5	48	9	40.5	40	1	26.6
1861	89	43	68.2	90	42	68.7	84	36	62.1	71	23	52.3	53	19	38.7	66	3	33.5
1862	91	44	70.2	90	41	70.6	87	34	64.1	81	24	52.0	72	18	39.4	59	— 3	32.7
1863	87	46	71.7	93	35	71.6	87	27	61.0	80	17	50.5	71	11	42.4	55	— 2	30.0
1864	94	43	74.2	96	38	72.9	84	31	61.4	72	24	48.2	68	12	40.5	57	— 3	30.1
1865	88	38	68.6	96	39	70.2	91	41	69.9	72	18	49.1	73	16	41.6	66	— 3	32.5
1866	98	41	75.6	83	35	65.1	89	26	60.2	80	20	53.5	63	14	41.0	55	—22	28.3

CHARLOTTE, NEW YORK.

TABLE B.—Maximum, minimum, and mean temperature for seasons and years from 1859 to 1866 inclusive.

Year.	Spring.			Summer.			Autumn.			Winter.			Year.			Range.
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	
1859	......	......	......	......	......	......	77	27	49.2	......	......	......	......	......	......	......
1860	77	10	46.1	92	41	66.9	79	9	49.9	63	— 8	26.0	92	2	47.5	90
1861	77	— 2	42.4	90	39	67.1	84	19	51.0	53	—20	26.5	90	—20	47.3	110
1862	84	9	43.7	91	34	67.8	87	18	51.8	68	0	28.3	91	— 3	47.8	94
1863	84	— 3	43.5	93	35	69.1	87	11	51.3	59	—14	30.6	93	—14	48.4	107
1864	80	2	44.6	96	32	71.4	84	12	50.0	64	—15	29.1	96	—15	48.8	111
1865	84	— 3	47.5	96	38	69.7	91	16	53.5	57	— 9	25.9	96	— 9	49.3	115
1866	84	0	43.5	98	32	69.0	89	14	51.6	66	—14	27.6	98	—22	47.6	120

CHARLOTTE, NEW YORK.

TABLE B.—Amount of rain and melted snow for months, seasons, and years, in United States inches and decimals.

Year.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Spring.	Summer.	Autumn.	Winter.	Year.
1859	......	......	......	......	......	......	2.20	4.30	2.66	1.01	2.07	3.42	......	......	5.74	......	......
1860	0.86	1.26	1.19	1.19	1.40	2.24	4.67	1.93	3.15	3.79	2.42	1.30	3.78	8.84	9.36	5.54	25.40
1861	1.55	2.02	2.05	2.28	3.67	1.52	4.62	3.76	5.93	2.54	1.18	1.60	8.00	9.90	9.65	4.87	32.72
1862	1.71	1.70	2.74	0.98	1.53	3.26	3.17	2.02	1.75	3.19	3.22	1.97	5.25	8.45	8.16	5.01	27.25
1863	1.74	2.33	1.54	2.18	1.44	1.51	4.60	1.88	1.23	1.92	2.75	1.76	5.16	7.99	5.90	6.04	24.88
1864	2.12	1.38	3.32	2.69	6.05	0.61	1.43	4.61	1.18	5.73	2.75	3.23	12.06	6.65	9.66	5.26	35.10
1865	2.42	1.17	3.85	3.05	3.17	3.40	1.46	1.17	3.16	4.70	2.14	1.94	10.07	6,03	10.00	6.82	31.63
1866	1.68	2.28	1.66	2.32	2.99	4.10	1.02	3.93	3.97	1.34	3.35	3.59	6.97	9.05	8.66	5.90	31.23

SACKETT'S HARBOR, NEW YORK.—ALTITUDE 266 FEET.

TABLE B.—Maximum, minimum, and mean barometrical pressure for each month from the year 1859 to 1866 inclusive, reduced to 32° Fahr. + 28 inches.

Year.	January.			February.			March.			April.			May.			June.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1859	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
1860	2.218	1.293	1.690	2.277	1.034	1.748	2.069	1.148	1.585	2.357	1.093	1.659	1.949	1.078	1.664	1.984	1.045	1.579
1861	2.446	1.215	1.681	2.431	0.996	1.652	2.274	1.180	1.723	2.204	1.148	1.666	2.081	0.810	1.610	1.902	1.246	1.638
1862	2.351	0.867	1.793	2.134	1.020	1.707	1.994	1.051	1.578	2.199	1.243	1.843	1.954	1.258	1.676	2.186	1.273	1.640
1863	2.503	1.114	1.759	2.555	1.080	1.873	2.290	1.161	1.730	2.118	0.823	1.708	1.948	1.080	1.661	1.911	1.106	1.628
1864	2.223	0.836	1.660	2.230	1.067	1.563	2.110	0.918	1.620	1.988	1.349	1.677	1.874	1.281	1.554	1.999	1.088	1.697
1865	2.245	1.301	1.676	2.318	1.107	1.775	2.186	0.859	1.666	2.250	1.182	1.730	2.106	1.220	1,646	1.918	1.368	1.719
1866	2.949	1.266	1.844	2.378	1.161	1.790	2.098	1.201	1.705	2.153	0.767	1.689	1.969	0.944	1.528	1.947	1.191	1.615

Year.	July.			August.			September.			October.			November.			December.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1859	2.207	1.245	1.724	1.931	1.379	1.636	2.152	1.147	1.727	2.129	1.200	1.690	2.336	1.042	1.789	2.479	1.314	1.781
1860	1.892	1.203	1.621	1.977	1.311	1.653	2.266	1.336	1.773	2.065	1.158	1.765	2.068	0.995	1.596	2.349	0.901	1.764
1861	1.905	1.315	1.631	1.994	1.432	1.737	2.174	0.888	1.721	2.196	1.142	1.724	2.076	1.135	1.592	2.291	1.239	1.825
1862	2.039	1.305	1.617	2.105	1.405	1.708	1.992	1.193	1.742	2.054	1.157	1.718	2.556	1.235	1.735	2.448	1.166	1.769
1863	1.980	1.435	1.676	2.069	1.472	1.715	2.186	1.245	1.802	2.326	1.426	1.803	2.272	1,204	1.672	2.392	0.887	1.821
1864	1.967	1.387	1.684	1.951	1.223	1.622	2.099	1.304	1.675	2.054	0.951	1.574	2.162	1.197	1.662	2.358	1.151	1.597
1865	2.043	1.357	1.687	2.043	1.340	1.772	2.133	1.564	1.788	2.162	0.999	1.675	2.054	1.105	1.655	2.191	1.130	1.751
1866	1.999	1.390	1.686	2.000	1.375	1.631	2.067	1.258	1.727	2.296	1.308	1.809	....	....	....	2.446	1.122	1.708

SACKETT'S HARBOR, NEW YORK. + 28 INCHES.

TABLE B.—Maximum, minimum, and mean barometrical pressure reduced to 32° Fahr., for seasons.

Year.	Spring.			Summer.			Autumn.			Winter.			Year.			Range.
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	
1859	....	....	....	....	....	....	2.366	1.042	1.734	....	....	....	....	....	....	....
1860	2.357	1.078	1.636	1.984	1.045	1.618	2.266	0.995	1.711	2.479	1.084	1.740	2.357	0.901	1.675	1.456
1861	2.274	0.810	1.666	1.994	1.246	1.669	2.196	0.888	1.679	2.446	0.901	1.699	2.446	0.810	1.683	1.636
1862	2.199	1.051	1.699	2.186	1.273	1.655	2.556	1.151	1.732	2.351	0.867	1.775	2.556	0.867	1.710	1.689
1863	2.290	0.823	1.699	2.069	1.106	1.673	2.326	1.204	1.759	2.555	1.080	1.800	2.555	0.823	1.737	1.732
1864	2.110	0.918	1.617	1.999	1.088	1.668	2.162	0.951	1.637	2.392	0.836	1.681	2.352	0.836	1.632	1.516
1865	2.250	0.859	1.647	2.043	1.340	1.719	2.162	0.999	1.709	2.352	1.107	1.683	2.318	0.859	1.703	1.459
1866	2.153	0.767	1.641	2.000	1.191	1.644	2.296	1.258	1.768	2.949	1.130	1.795	2.949	0.767	1.703	2.182

SACKETT'S HARBOR, NEW YORK.

TABLE B.—Maximum, minimum, and mean temperature for each month from the year 1859 to 1866 inclusive.

Year.	January.			February.			March.			April.			May.			June.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1859	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
1860	46	—21	23.5	52	—11	23.6	61	12	34.6	66	17	42.0	76	39	60.0	80	50	64.8
1861	37	—36	18.0	50	—46	25.7	56	—13	27.3	70	18	43.0	66	26	49.4	77	44	62.0
1862	46	—13	19.8	43	—21	21.1	45	1	28.7	72	18	41.4	81	36	53.6	83	36	62.2
1863	56	—20	29.5	50	—30	23.2	57	—34	24.7	63	7	42.0	80	32	56.4	84	45	63.8
1864	50	—20	26.2	49	—24	27.2	52	0	31.9	64	28	43.5	76	33	58.9	85	42	65.8
1865	38	—15	17.5	48	—40	20.0	69	— 9	36.7	70	27	47.3	80	38	56.6	88	52	69.7
1866	58	—26	19.4	51	—20	23.3	55	2	29.7	73	22	47.2	74	31	52.2	82	61	65.6

SACKETT'S HARBOR, NEW YORK.

TABLE B.—Maximum, minimum, and mean temperature for each month from the year 1859 to 1866 inclusive.

Year.	July.			August.			September.			October.			November.			December.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1859	85	49	69.1	86	51	69.9	75	41	59.2	75	23	45.9	61	23	39.8	57	—21	20.4
1860	77	57	66.4	87	44	68.1	79	28	59.0	71	29	50.1	73	16	40.3	43	—15	22.5
1861	85	50	67.7	85	45	67.6	79	43	61.0	70	26	50.9	53	15	37.6	61	— 8	30.5
1862	82	50	69.6	88	43	71.1	84	40	65.0	82	27	52.4	64	10	37.9	49	—14	26.3
1863	85	52	72.4	93	45	71.6	83	33	60.7	76	23	51.0	65	14	43.1	55	— 5	26.3
1864	91	54	73.3	92	52	73.0	80	37	61.6	70	34	49.8	68	14	40.3	53	—12	28.7
1865	84	48	69.2	89	47	72.8	88	39	68.9	66	24	47.7	54	17	41.6	58	— 3	31.4
1866	88	49	74.3	81	46	66.3	85	37	60.7	77	26	53.2	....	....	....	54	—30	27.3

SACKETT'S HARBOR, NEW YORK.

TABLE B.—Maximum, minimum, and mean temperature for seasons and years from 1859 to 1866 inclusive.

Year.	Spring.			Summer.			Autumn.			Winter.			Year.			Range.
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	
1859	....	....	....	....	....	....	75	23	48.3	....	....	....	....	....	....	....
1860	76	12	55.6	87	44	66.4	79	16	49.8	57	—21	22.5	87	—21	46.3	108
1861	70	—13	39.9	85	44	65.7	79	15	49.8	50	—46	22.1	85	—46	45.0	131
1862	81	1	41.2	88	36	67.7	84	10	51.8	61	—21	23.8	88	—21	45.8	109
1863	80	—34	41.0	93	45	69.3	83	14	51.6	56	—30	26.3	93	—34	47.1	127
1864	76	0	44.8	92	42	70.7	80	14	50.6	55	—24	26.6	92	—24	48.4	116
1865	80	— 9	47.2	89	47	70.6	88	17	52.7	53	—40	22.1	89	—40	48.4	128
1866	74	2	43.0	88	46	68.7	85	24.7	....	58	—26	24.7	88	—30	47.2	119

SACKETT'S HARBOR, NEW YORK,

TABLE B.—Amount of rain and melted snow for months, seasons, and years, in United States inches and decimals.

Year.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Spring.	Summer.	Autumn.	Winter.	Year.
1859	....	....	....	....	....	....	1.62	3.28	2.64	0.98	4.16	5.18	....	....	7.78	....	....
1860	1.95	1.52	1.39	1.26	1.88	2.11	4.79	2.90	3.70	3.64	6.52	2.96	4.53	9.80	13.86	8.65	34.62
1861	2.66	5.82	2.68	2.70	4.48	2.10	6.32	4.04	5.80	4.62	3.38	1.30	9.86	12.46	13.80	11.44	45.90
1862	1.13	1.46	4.20	2.14	2.42	1.68	3.60	1.64	2.96	3.72	2.54	2.27	8.76	6.92	6.22	3.89	29.76
1863	2.26	3.08	2.07	3.34	2.02	2.34	2.56	3.44	2.40	5.44	4.70	4.50	7.43	8.34	12.54	7.61	38.15
1864	2.56	1.78	2.72	4.80	6.76	1.14	1.14	3.02	2.94	5.94	5.36	3.38	14.28	5.30	14.24	8.84	41.34
1865	1.58	1.22	3.94	3.30	2.59	4.08	2.28	0.56	1.73	4.78	2.26	2.30	9.83	6.92	8.77	6.18	30.62
1866	1.26	2.70	2.82	2.88	3.22	3.84	1.50	5.88	5.34	2.90	4.12	2.46	8.92	11.22	12.36	6.26	38.92

TABLE C.—*Maximum, minimum, and mean of the barometrical pressure reduced to 32° Fahr. + 28 inches.*

Year.	No. of years.	January.			February.			March.			April.			May.			June.		
		Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
Superior City	7	2.371	0.547	1.343	1.916	0.513	1.320	2.018	0.567	1.303	1.878	0.245	1.288	1.762	0.259	1.257	1.753	0.685	1.270
Ontonagon	6	1.893	0.359	1.285	1.946	0.444	1.311	1.929	0.502	1.286	1.859	0.311	1.319	1.897	0.214	1.267	1.789	0.412	1.299
Marquette	7	2.421	0.548	1.282	1.853	0.444	1.264	1.957	0.495	1.261	1.848	0.382	1.278	1.750	0.284	1.232	1.734	0.619	1.242
Milwaukee	7	2.503	0.665	1.399	1.921	0.529	1.381	1.888	0.655	1.329	1.999	0.511	1.333	1.753	0.447	1.298	1.730	0.770	1.342
Grand Haven	4	1.971	0.620	1.379	1.880	0.352	1.358	1.827	0.499	1.318	1.867	0.568	1.336	1.717	0.567	1.310	1.694	0.695	1.347
Thunder Bay Island	7	1.979	0.563	1.352	1.992	0.551	1.344	1.887	0.050	1.279	1.984	0.481	1.351	1.842	0.530	1.323	1.824	0.732	1.349
Tawas City	8	2.611	0.635	1.390	2.017	0.573	1.360	1.899	0.050	1.302	1.981	0.556	1.358	1.849	0.545	1.316	1.900	0.627	1.341
Detroit	8	2.630	0.656	1.413	2.073	0.637	1.387	1.872	0.469	1.316	1.958	0.562	1.327	1.752	0.658	1.301	1.782	0.608	1.336
Monroe City	7	2.641	0.690	1.440	2.039	0.646	1.418	1.947	0.628	1.352	1.990	0.648	1.365	1.759	0.600	1.318	1.715	0.704	1.362
Cleveland	7	2.509	0.731	1.366	1.969	0.685	1.348	1.753	0.535	1.272	1.894	0.547	1.299	1.820	0.539	1.243	1.703	0.628	1.300
Buffalo	7	2.526	0.606	1.390	2.146	0.596	1.383	1.886	0.570	1.308	2.007	0.536	1.357	1.707	0.390	1.290	1.832	0.679	1.326
Fort Niagara	6	2.957	0.958	1.778	2.413	1.068	1.758	2.400	0.828	1.703	2.322	0.980	1.739	2.144	0.936	1.645	2.224	1.104	1.649
Charlotte	7	2.989	0.906	1.746	2.542	0.930	1.737	2.311	0.867	1.654	2.355	0.795	1.713	2.103	0.679	1.623	2.183	0.970	1.656
Sackett's Harbor	7	2.949	0.836	1.729	2.555	0.996	1.730	2.290	0.859	1.658	2.357	0.767	1.710	2.106	0.810	1.620	2.186	1.088	1.645

TABLE C.—*Maximum, minimum, and mean of the barometrical pressure reduced to 32° Fahr. + 28 inches.*

Year.	No. of years.	July.			August.			September.			October.			November.			December.		
		Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
Superior City	7	1.765	0.692	1.279	1.650	0.810	1.308	1.839	0.680	1.307	2.026	0.388	1.317	2.004	0.463	1.282	2.019	0.393	1.347
Ontonagon	6	1.747	0.648	1.288	1.785	0.772	1.312	1.840	0.667	1.335	1.963	0.314	1.300	2.043	0.385	1.284	2.071	0.452	1.316
Marquette	7	1.676	0.700	1.267	1.663	0.758	1.301	1.861	0.703	1.273	1.852	0.434	1.286	2.157	0.355	1.243	1.975	0.312	1.273
Milwaukee	7	1.696	0.902	1.354	1.702	0.971	1.366	1.828	0.803	1.372	1.967	0.658	1.370	2.040	0.549	1.333	2.032	0.552	1.387
Grand Haven	4	1.673	0.892	1.341	1.689	1.033	1.386	1.864	0.950	1.421	1.842	0.665	1.394	1.974	0.588	1.325	2.248	0.723	1.442
Thunder Bay Island.	7	1.806	0.782	1.351	1.690	0.809	1.372	1.903	0.753	1.404	1.950	0.658	1.362	2.129	0.421	1.326	2.069	0 519	1.383
Tawas City	8	1.815	0.807	1.351	1.731	0.860	1.375	1.892	0.792	1.412	1.986	0.689	1.386	2.132	0.441	1.332	2.109	0.472	1.388
Detroit	8	1.692	0.933	1.357	1.786	0.946	1.383	1.869	0.983	1.421	1.979	0.708	1.398	2.099	0.637	1.360	2.039	0.636	1.413
Monroe City	7	1.854	0.922	1.384	1.720	0.962	1.396	1.881	1.012	1.442	1.928	0.757	1.433	2.059	0.692	1.396	2.101	0.661	1.443
Cleveland..........	7	1.776	0.905	1.316	1.699	0.875	1.329	1.797	0.903	1.369	1.843	0.682	1.347	2.022	0.512	1.316	2.016	0.528	1.373
Buffalo	7	1.875	0.990	1.351	1.822	0.888	1.370	1.862	0.822	1.415	1.902	0.578	1.378	2.145	0.429	1.351	2.117	0.493	1.398
Fort Niagara.......	6	2.088	1.306	1.700	2.183	1.248	1.729	2.297	1.118	1.781	2.355	0.880	1.759	2.617	0.876	1.721	2.521	0.965	1.765
Charlotte	7	2.202	1.248	1.674	2.133	1.175	1.690	2.218	1.147	1.751	2.329	0.767	1.717	2.553	0.704	1.687	2.501	0.892	1.751
Sackett's Harbor...	7	2.207	1.203	1.663	2.105	1.223	1.684	2.266	0.888	1.774	2.326	0.951	1.720	2.556	0.995	1.672	2.479	0.887	1.752

TABLE C.—*Maximum, minimum, and mean of the barometrical pressure reduced to 32° Fahr. for seasons and years, + 28 inches.*

Year.	No. of years.	Spring.			Summer.			Autumn.			Winter.			Year.			Range.
		Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	
Superior City....................	7	2.018	0.245	1.298	1.765	0.685	1.286	2.026	0.463	1.302	2.371	0.393	1.339	2.371	0.393	1.301	1.978
Ontonagon	5	1.929	0.214	....	1.789	0.412	....	2.043	0.314	....	2.017	0.359	....	2.043	0.314	....	1.729
Marquette........................	7	1.957	0.284	1.257	1.734	0.619	1.262	2.157	0.355	1.275	2.421	0.312	1.265	2.421	0.312	1.262	2.109
Milwaukee	7	1.999	0.447	1.320	1.730	0.770	1.352	2.040	0.549	1.360	2.503	0.529	1.391	2.503	0.447	1.358	2.056
Grand Haven......................	3	1.867	0.499	1.309	1.694	0.695	1.354	1.974	0.588	1.381	2.248	0.352	1.393	2.248	0.352	1.353	1.896
Thunder Bay Island...............	7	1.984	0.050	1.320	1.824	0.677	1.357	2.129	0.421	1.364	2.069	0.519	1.358	2.129	0.050	1.344	2.079
Tawas City.......................	8	1.981	0.059	1.325	1.900	0.627	1.354	2.132	0.441	1.176	2.611	0.573	1.381	2.611	0.059	1.359	2.552
Detroit..........................	7	1.958	0.469	1.314	1.786	0.608	1.359	2.099	0.637	1.393	2.630	0.637	1.405	2.630	0.552	1.368	2.078
Monroe City......................	7	1.990	0.600	1.345	1.747	0.704	1.377	2.059	0.692	1.419	2.641	0.646	1.436	2.641	0.600	1.392	2.041
Cleveland	7	1.894	0.534	1.271	1.776	0.628	1.314	2.022	0.512	1.344	2.509	0.528	1.363	2.509	0.312	1.321	1.997
Buffalo..........................	7	2.007	0.390	1.318	1.832	0.679	1.344	2.145	0.429	1.381	2.526	0.544	1.393	2.526	0.390	1.359	2.136
Fort Niagara.....................	6	2.400	0.905	1.695	2.224	1.104	1.710	2.499	0.880	1.754	2.957	0.958	1.756	2.957	0.880	1.732	2.077
Charlotte........................	7	2.335	0.679	1.661	2.183	0.970	1.672	2.553	0.704	1.714	2.989	0.892	1.746	2.989	0.679	1.699	2.310
Sackett's Harbor	7	2.357	0 767	1.658	2.186	1.045	1.664	2.556	0.888	1.716	2.949	0.836	1.739	2.949	0.767	1.692	2.182

TABLE D.—*Maximum, minimun, and mean temperature for months, seasons, and years.*

Stations.	No. of years.	January.			February.			March.			April.			May.			June.		
		Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
Superior City	7	53	—37	12.8	55	—38	14.5	69	—21	24.7	70	— 5	36.3	92	18	47.5	96	29	56.2
Ontonagon	6	45	—34	16.4	48	—37	16.4	61	—22	23.7	75	— 5	37.3	94	19	49.2	97	30	59.3
Marquette	7	51	—25	18.3	53	—33	18.0	63	—19	25.0	74	3	38.3	93	16	51.2	101	30	60.5
Milwaukee	7	50	—30	21.7	56	—18	24.7	69	— 5	32.2	76	16	43.2	91	27	53.5	97	39	64.3
Grand Haven	4	65	— 5	25.8	52	—16	25.5	63	1	33.0	76	8	45.2	88	27	56.1	88	28	65.4
Thunder Bay Island	7	47	—17	22.7	47	—25	22.7	49	—11.5	28.5	62	8	37.0	72	25	46.5	90	35	57.2
Tawas City	8	50	—25	22.1	57	—25	23.3	56	—19	30.7	61	9	39.9	81	17	51.7	90	27	61.7
Detroit	7	63	—19	28.5	64	—14	28.1	75	5	35.2	89	12	46.5	87	25	58.5	95	38	68.2
Monroe City	7	73	—15	26.0	61	—19	28.0	75	— 7.5	34.4	78	19	46.6	92	29	59.0	101	38	69.2
Cleveland	7	66	—14	26.9	71	—14	29.3	75	7	35.8	84	17	47.7	91	31	58.4	94	39	68.0
Buffalo	7	60	—13	24.9	63	—12	25.8	67	— 2	31.9	77	12	44.0	86	26	54.5	96	28	64.6
Fort Niagara	7	56	— 9	26.8	60	—15	26.3	63	3	31.3	75	14	41.4	82	18	51.9	90	40	63.4
Charlotte	7	64	—15	26.0	58	—20	27.3	66	— 3	33.1	77	7	44.7	84	23	55.5	93	32	65.8
Sackett's Harbor	7	58	—36	22.0	52	—46	23.4	69	—34	30.5	73	7	43.8	81	26	55.3	88	36	64.8

Stations.	No. of years.	July.			August.			September.			October.			November.			December.		
		Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
Superior City	7	99	35	63.7	97	33	63.2	88	21	54.6	84	15	42.9	66	—15	30.3	49	—31	14.5
Ontonagon	6	97	34	64.0	98	33	64.6	89.5	20	54.9	82	16	43.5	55	— 3	31.1	49	—20	19.9
Marquette	7	103	33	65.2	100	38	64.3	93	23	56.6	85	15	44.5	69	— 2	33.4	60.5	—19	21.8
Milwaukee	7	97	44	69.2	97	41	68.2	88	31	61.2	79	23	48.4	69	— 3	37.5	59	—19	25.2
Grand Haven	4	90	33	70.1	91	48	70.3	81	28	60.4	75	17	49.8	62	9	38.0	57	0	28.7
Thunder Bay Island	7	90	41	64.1	93	40	65.6	81	33	57.7	72.5	26	46.3	60.5	8	36.9	51	— 5	26.0
Tawas City	8	86	40.5	67.1	87	31.5	66.4	85	28	58.8	75	20	47.5	59	11	37.1	60	— 6	26.1
Detroit	7	95	43	70.5	98	37	69.2	88	31	61.9	82	23	50.0	80	7	39.0	65	— 4	28.6
Monroe City	7	103	41	74.0	99	34	72.0	93	27	63.5	86	24	51.2	71	5	40.1	59	—13	29.1
Cleveland	7	97	48	72.2	93	43	70.7	88	35	63.7	85	30	51.9	75	5	41.7	68	— 9	30.6
Buffalo	7	93	45	69.6	94	39	68.5	90	28	61.2	80	24	49.9	73	9	39.9	61	— 9	28.9
Fort Niagara	7	93	51	69.6	89	46	68.6	86	33	60.7	82	27	49.8	67	14	39.9	63	— 8	28.8
Charlotte	7	98	38	70.6	96	35	69.5	91	26	62.1	84	17	50.4	73	9	40.7	66	—22	29.6
Sackett's Harbor	7	91	48	70.2	93	43	70.0	88	28	62.0	82	23	50.1	73	10	40.1	61	—30	26.7

TABLE D.—*Maximum, minimum, and mean temperature for months, seasons, and years.*

Stations.	No. of years.	Spring.			Summer.			Autumn.			Winter.			Year.			Range.
		Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	
Superior City	7	92	—21	35.8	99	29	60.9	88	—15	42.6	55	—38	13.9	99	—38	38.5	1.37
Ontonagon	5	94	—15	....	98	30	....	89.5	— 3	....	49	—37	....	98	—37	....	1.35
Marquette	7	93	—19	37.9	103	30	63.3	93	— 2	44.8	53	—33	19.4	10.3	—33	41.5	1.36
Milwaukee	7	91	— 5	43.0	97	39	67.3	88	— 3	49.0	57	—30	24.0	97	—30	45.8	1.27
Grand Haven	3	88	1	44.8	91	40	68.6	81	9	49.4	65	—16	20.7	91	—16	47.3	1.07
Thunder Bay Island	7	72	—11.5	37.4	93	35	62.3	81	8	47.0	51	—25	23.8	93	—25	42.6	1.18
Tawas City	8	81	—10	40.3	90	27	65.0	83.5	11	47.8	60	—25	23.7	90	—25	44.2	1.15
Detroit	7	89	5	46.7	98	37	68.8	88	7	50.2	65	—19	28.1	98	—19	48.1	1.17
Monroe City	7	92	4	46.7	10.3	34	71.7	93	5	51.6	73	—19	27.7	103	—19	49.5	1.22
Cleveland	7	91	7	47.3	97	39	70.2	88	5	52.4	71	—14	29.1	97	—14	49.8	1.11
Buffalo	7	86	— 2	43.5	96	28	67.0	90	9	50.3	63	—22	26.7	96	—22	47.0	1.18
Fort Niagara	7	82	3	41.5	93	40	67.2	86	14	50.1	63	—15	27.4	93	—15	46.6	1.08
Charlotte	7	84	— 3	44.5	98	32	68.7	91	9	51.0	66	—20	27.7	98	—20	48.1	1.18
Sackett's Harbor	7	81	—34	44.7	93	36	68.4	88	10	50.7	61	—46	24.0	93	—46	46.9	1.31

TABLE E.—*Mean amount of rain and melted snow in United States inches and decimals for months, seasons, and years.*

Stations.	No. of years.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Spring.	Summer.	Autumn.	Winter.	Year.
Superior City	7	0.91	1.59	1.44	2.03	2.60	2.34	3.01	3.12	3.68	2.33	1.31	0.77	6.35	8.82	7.31	3.29	25.75
Ontonagon	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
Marquette	7	2.10	2.18	1.99	2.23	1.90	3.21	2.79	3.02	2.80	2.68	2.62	2.12	6.15	8.90	8.15	6.45	30.30
Milwaukee	7	2.20	1.78	2.10	2.55	3.41	2.73	3.54	2.46	3.42	2.48	2.04	2.04	8.06	9.06	7.94	5.88	31.32
Grand Haven	4	1.62	1.28	1.16	1.06	3.11	1.62	2.22	3.87	2.60	2.32	2.79	1.73	5.33	8.59	7.72	4.64	25.32
Thunder Bay Island	7	3.20	2.65	2.83	3.07	2.07	2.33	2.86	2.25	3.84	2.79	2.45	2.89	7.97	7.44	9.08	8.25	33.22
Tawas City	8	1.45	0.96	2.16	2.28	1.71	1.82	1.71	2.24	2.52	2.10	1.97	1.39	6.16	5.76	6.60	3.95	22.32
Detroit	8	1.27	1.45	2.71	2.41	2.33	2.99	3.16	2.94	3.32	2.61	2.01	1.94	7.44	9.10	7.94	4.79	29.56
Monroe City	7	1.61	1.48	2.72	2.65	2.50	2.58	3.26	3.30	3.87	2.37	2.22	2.28	7.87	9.40	8.46	5.41	31.39
Cleveland	7	2.95	2.15	2.98	3.30	3.16	5.40	3.06	3.25	4.12	3.22	3.64	3.23	9.43	9.97	10.56	8.34	38.38
Buffalo	7	2.21	1.84	2.80	2.43	3.12	1.69	2.54	3.48	3.79	3.09	2.43	2.82	8.35	7.95	9.31	6.66	33.07
Fort Niagara	7	2.16	1.90	2.56	1.94	2.68	1.52	2.95	2.47	2.58	2.75	2.71	2.35	6.53	7.30	7.71	6.44	27.94
Charlotte	7	1.73	1.73	2.34	2.10	2.89	2.38	2.90	2.95	2.88	3.03	2.48	2.35	7.33	8.13	8.27	5.63	29.74
Sackett's Harbor	7	1.91	2.51	2.83	2.91	3.34	2.47	2.98	3.10	3.44	4.00	4.13	3.04	9.09	8.71	11.20	7.55	37.04

TABLE F.—*Yearly mean and range of barometric pressure reduced to 32° Fahr. + 28 inches.*

	1859.		1860.		1861.		1862.		1863.		1864.		1865.		1866.	
	Mean.	Range.	Mean.	Range.	Mean.	Range.	Mean.	Range.	Mean.	Range.	Mean.	Range.	Mean.	Range.	Mean.	Range.
Superior City, Wis	....	(1.327)	1.276	1.544	1.274	1.724	1.324	1.355	1.322	1.585	1.288	1.315	1.308	1.487	1.318	1.766
Ontonagon	....	1.306	1.302	1.538	1.282	1.715	1.323	1.441	1.332	1.504	1.252	1.476	....	....	....	....
Marquette	....	....	1.271	1.598	1.268	1.673	1.289	1.622	1.313	1.421	1.179	1.428	1.252	1.650	1.259	1.987
Thunder Bay Island	1.358	2.019	1.321	1.533	1.333	1.449	1.309	1.429	1.375	1.458	1.312	1.520	(1.389)	....	....	....
Tawas City	1.368	2.073	1.342	1.465	1.341	1.444	1.376	1.475	1.399	1.389	1.314	1.596	1.384	1.483	1.348	2.139
Milwaukee, Wis	....	....	1.358	1.492	1.345	1.511	1.377	1.393	1.379	1.129	1.307	1.418	1.373	1.222	1.370	1.888
Grand Haven	....	....	1.353	1.560	1.346	1.527	1.360	1.434	....	....	....	....	....	....	....	....
Detroit	....	....	1.352	1.426	1.347	1.293	1.370	1.376	1.373	1.395	1.330	1.411	1.394	1.327	1.413	1.966
Monroe City	....	....	1.395	1.413	1.392	1.313	1.420	1.398	1.410	1.364	1.335	1.404	1.401	1.323	1.393	2.041
Cleveland	....	....	1.317	1.442	1.308	1.285	1.331	1.385	1.343	1.340	1.267	1.465	1.338	1.413	1.341	1.970
Buffalo	....	....	1.367	1.354	1.357	1.653	1.382	1.481	1.397	1.610	1.282	1.564	1.379	1.437	1.346	2.033
Fort Niagara, N. Y	....	....	....	....	1.707	1.530	1.746	1.712	1.749	1.494	1.683	1.310	1.739	1.573	1.771	1.979
Charlotte, N. Y	....	....	1.665	1.405	1.679	1.783	1.707	1.608	1.749	1.787	1.641	1.659	1.738	1.652	1.715	2.164
Sackett's Harbor	....	....	1.675	1.456	1.683	1.636	1.710	1.689	1.737	1.732	1.632	1.516	1.703	1.459	1.703	2.182

TABLE G.—*Yearly mean and range of temperature.*

	1859.		1860.		1861.		1862.		1863.		1864.		1865.		1866.	
	Mean.	Range.	Mean.	Range.	Mean.	Range.	Mean.	Range.	Mean.	Range.	Mean.	Range.	Mean.	Range.	Mean.	Range.
Superior City, Wis	....	....	32.2	120	38.1	120	37.6	121	39.0	132	38.8	134	39.3	120	37.4	130
Ontonagon	....	....	40.3	110	40.5	132	38.6	119	40.3	103	40.6	132	....	....	....	....
Marquette	....	....	41.0	109	41.0	130	40.1	121	41.8	120	42.7	132	43.3	112.5	40.8	126
Thunder Bay Island	41.3	84	41.7	82	42.6	107	42.9	95	42.9	87	43.2	113	(43.8)	93.5	....	....
Tawas City	44.4	89	44.7	95	44.5	110	43.9	95	44.1	96	44.3	106	44.7	95	43.4	....
Milwaukee, Wis	....	....	46.8	99	46.6	113	45.5	114	46.6	103	44.9	127	46.0	103	44.4	115
Grand Haven	....	....	47.3	86	47.4	107	47.2	94	....	....	....	....	....	....	....	....
Detroit	....	....	47.8	103	48.7	112	48.3	94	48.4	94	48.1	114	49.3	96	46.0	106
Monroe City	....	....	48.7	104	49.3	108	49.6	101	49.4	104	49.5	117	50.6	105	49.4	122
Cleveland	....	....	49.8	87	50.4	104	49.4	89	49.5	88	49.5	108	50.9	101	49.2	111
Buffalo	....	....	47.1	93	47.4	109	47.6	93	47.5	94	46.8	105	47.4	103	45.5	93
Fort Niagara, N. Y	....	....	46.2	86	46.5	103	47.0	83	46.5	82	46.9	100	47.0	88	46.4	96
Charlotte, N. Y	....	....	47.5	90	47.3	110	47.8	94	48.4	107	48.8	111	49.3	115	47.6	120
Sackett's Harbor	....	....	46.3	108	45.0	131	45.8	109	47.1	127	48.4	116	48.4	129	47.2	118

TABLE I.—*Meteorological observations at Thunder Bay Island, in Lake Huron, Michigan, made under the direction of Lieut. Col. W. F. Raynolds, U. S. corps of engineers, brevet brigadier general, superintendent of the survey of the northern and northwestern lakes.*

[Latitude of station, 45° 02′ 17″ N. Longitude W. of Greenwich, 83° 09′ 26″. Observer, J. J. MALDEN.]

Date.	Time of observation.	Pressure reduced to 32° Fahr.		Temp., Fahr.		Vapor.		Am't of rain and melted snow, U. S. inches and decimals.	Am't cloudiness. (10=sky entirely overcast, 0=clear sky.)	Wind.					
		Total, U. S. inches and decimals.	Gaseous, U. S. inches and decimals.	Dry bulb.	Wet bulb.	Elasticity, U. S. inches and decimals.	Humidity. Saturation = 1.000.			Observed direction; from whence.	Observed velocity; miles per hour.	Resolution of directio and velocity, in mile per hour. N.	S.	E.	W.
	A. M.			°	°					°					
December, 1863	0. 30	29. 446	29. 331	26. 5	24. 5	. 115	. 744	....	7. 4	S. 85 W.	1. 0	......	2. 9	....	31. 2
January, 1864	0. 30	29. 270	29. 175	21. 3	19. 5	. 095	. 724	....	7. 3	N. 60 W.	4. 2	67. 4	....	....	118. 8
February, 1864	0. 30	29. 198	29. 095	22. 5	20. 7	. 103	. 726	....	8. 0	N. 62 W.	2. 4	34. 8	....	....	65. 7
March, 1864	0. 30	29. 262	29. 159	23. 6	21. 7	. 103	. 729	....	6. 1	N. 10 W.	2. 8	86. 2	....	....	15. 1
April, 1864	0. 30	29. 354	29. 196	34. 3	32. 2	. 158	. 793	....	7. 4	N. 42 E.	2. 0	43. 4	....	39. 0	......
May, 1864	0. 30	29. 275	29. 048	43. 3	40. 7	. 226	. 789	....	7. 1	N. 4 W.	3. 6	110. 5	....	....	7. 7
June, 1864	0. 30	29. 421	29. 073	54. 6	51. 1	. 348	. 761	....	3. 4	N. 32 W.	3. 2	82. 9	....	....	50. 8
July, 1864	0. 30	29. 405	28. 934	62. 8	59. 5	. 471	. 813	....	4. 0	N. 45 W.	1. 7	35. 2	....	....	37. 8
August, 1864	0. 30	29. 330	28. 825	65. 9	61. 7	. 505	. 775	....	5. 6	N. 32 W.	2. 8	73. 5	....	....	47. 3
September, 1864	0. 30	29. 367	29. 019	54, 2	51. 2	. 348	. 802	....	5. 6	N. 68 E.	0. 7	31. 6	....	76. 6	......
October, 1864	0. 30	29. 299	29. 073	42. 7	40. 4	. 226	. 804	....	7. 9	N. 36 W.	2. 5	63. 0	....	....	46. 5
November, 1864	0. 30	29. 298	29. 126	34. 5	32. 3	. 163	. 773	....	8. 1	S. 76 W.	4. 6	......	33. 8	....	132. 5
December, 1864	0. 30	29. 259	29. 159	22. 4	20. 7	. 100	. 721	....	8. 2	N. 67 W.	6. 2	76. 5	....	....	176. 9
January, 1865	0. 30	29. 365	29. 298	16. 6	14. 6	. 067	. 648	....	7. 9	N. 41 W.	3. 9	90. 2	....	....	77. 0
February, 1865	0. 30	29. 458	29. 376	20. 5	18. 4	. 082	. 680	....	8. 1	N. 21 W.	1. 0	25. 1	....	....	9. 4
March, 1865	0. 30	29. 317	29. 205	25. 6	23. 5	. 112	. 705	....	7. 4	N. 22 W.	3. 2	94. 3	....	....	37. 1
April, 1865	0. 30	29. 369	29. 219	33. 7	31. 3	. 150	. 756	....	5. 9	N. 9 W.	1. 6	46. 5	....	....	7. 2
May, 1865	0. 30	29. 353	29. 153	41. 4	38. 5	. 200	. 754	....	4. 9	N. 4 E.	2. 5	77. 9	....	5. 9	......
June, 1865	0. 30	29. 366	29. 028	53. 2	50. 5	. 338	. 819	....	5. 6	S. 3 W.	0. 3	......	11. 2	....	0. 5
July, 1865	0. 30	29. 405	29. 037	57. 4	53. 7	. 368	. 770	....	5. 7	N. 25 W.	2. 6	74. 1	....	....	35. 4
August, 1865	0. 30	29. 459	29. 058	59. 4	55. 8	. 401	. 780	....	3. 1	N. 20 W.	1. 3	36. 3	....	....	13. 1
September, 1865	0. 30	29. 451	28. 991	61. 7	58. 7	. 460	. 826	....	4. 3	S. 20 W.	0. 7	......	....	....	6. 9
October, 1865	0. 30	29. 399	29. 167	43. 8	41. 1	. 232	. 774	....	7. 7	N. 13 E.	4. 6	41. 9	19. 1	31. 7	......
November, 1865	0. 30	29. 426	29. 246	38. 7	35. 9	. 180	. 741	....	6. 6	S. 70 W.	2. 7	......	....	....	74. 6
December, 1865	....	......	......	....	....	....	....	....	....	....	....	......	26. 9	....	......
Mean of spring	0. 30	29. 322	29. 163	33. 6	31. 3	. 158	. 754	....	6. 5	N. 2 W.	2. 5	458. 8	....	....	22. 2
Mean of summer	0. 30	29. 398	28. 992	58. 9	55. 4	. 405	. 786	....	4. 6	N. 34 W.	1. 8	290. 8	....	....	184. 9
Mean of autumn	0. 30	29. 373	29. 104	45. 9	43. 3	. 268	. 787	....	6. 7	N. 1 W.	1. 2	227. 2	....	....	5. 5
Mean of winter	0. 30	29. 333	29. 239	21. 6	19. 7	. 094	. 707	....	7. 8	N. 58 W.	3. 1	291. 1	....	....	479. 0
Means of all	0. 30	29. 356	29. 124	40. 0	37. 4	. 231	. 759	....	6. 4	N. 28 W.	1. 9	1267. 9	....	....	691. 6
	P. M.														
December, 1863	12	29. 405	29. 288	27. 1	25. 0	. 117	. 736	0. 06	8. 0	S. 5 W.	1. 2	......	35. 9	....	3. 2
January, 1864	12	29. 294	29. 198	21. 4	19. 6	. 096	. 722	0. 18	7. 3	N. 60 W.	3. 9	62. 3	....	....	105. 6
February, 1864	12	29. 212	29. 113	22. 1	20. 3	. 099	. 705	0. 09	7. 1	N. 57 W.	3. 8	59. 0	....	....	93. 0
March, 1864	12	29. 252	29. 147	24. 3	22. 3	. 105	. 727	0. 01	6. 5	N. 18 W.	2. 4	71. 4	....	....	22. 8
April, 1864	12	29. 357	29. 195	34. 7	32. 6	. 161	. 798	0. 21	7. 3	N. 47 E.	2. 0	40. 2	....	43. 7	......
May, 1864	12	29. 278	29. 052	43. 6	40. 9	. 226	. 779	0. 07	6. 5	N. 6 W.	4. 3	130. 6	....	....	14. 4
June, 1864	12	29. 419	29. 063	55. 1	51. 7	. 356	. 773	0. 50	3. 5	N. 53 W.	2. 2	39. 6	....	....	52. 9
July. 1864	12	29. 399	28. 918	63. 4	60. 1	. 482	. 814	0. 04	3. 9	N. 51 W.	1. 1	22. 8	....	....	27. 1
August, 1864	12	29. 343	28. 844	65. 9	61. 5	. 499	. 764	0. 02	5. 2	N. 31 W.	3. 3	86. 4	....	....	54. 3
September, 1864	12	29. 372	29. 032	54. 2	50. 8	. 340	. 791	0. 16	5. 3	N. 64 E.	3. 4	44. 1	....	91. 3	......
October, 1864	12	29. 303	29. 077	42. 6	40. 4	. 227	. 806	0. 11	8. 1	N. 42 W.	3. 0	68. 2	....	....	61. 1
November, 1864	12	29. 291	29. 121	34. 8	32. 5	. 170	. 782	0. 12	7. 8	S. 75 W.	4. 4	......	34. 0	....	126. 2
December, 1864	12	29. 262	29. 165	22. 0	20. 1	. 097	. 720	0. 11	8. 6	N. 67 W.	6. 4	78. 6	....	....	181. 8
January, 1865	12	29. 370	29. 300	17. 3	15. 3	. 070	. 654	0. 07	7. 9	N. 42 W.	3. 5	81. 8	....	....	73. 4
February, 1865	12	29. 458	29. 376	20. 8	18. 7	. 082	. 674	0. 04	8. 3	N. 22 W.	1. 3	33. 0	....	....	13. 1
March, 1865	12	29. 299	29. 185	26. 3	24. 1	. 114	. 703	0. 21	7. 2	N. 23 W.	3. 2	90. 0	....	....	39. 3
April, 1865	12	29. 381	29. 220	34. 4	31. 8	. 151	. 743	0. 49	6. 3	N. 27 W.	0. 7	19. 8	....	....	10. 1
May, 1865	12	29. 358	29. 152	42. 5	39. 4	. 206	. 745	0. 07	4. 9	N. 1 E.	2. 8	86. 0	....	1. 8	......
June, 1865	12	29. 358	20. 012	53. 6	51. 0	. 346	. 823	0. 17	5. 5	S. 6 E.	0. 4	......	10. 9	1. 1	......
July, 1865	12	29. 412	29. 039	58. 2	54. 2	. 372	. 756	0. 12	6. 0	N. 24 W.	2. 7	75. 6	....	....	33. 9
August, 1865	12	29. 451	29. 050	59. 9	56. 1	. 404	. 773	....	3. 2	N. 25 W.	1. 4	39. 8	....	....	18. 0
September, 1865	12	29. 443	28. 993	61. 3	58. 1	. 450	. 818	....	4. 5	S. 54 W.	0. 5	......	9. 3	....	12. 6
October. 1865	12	29. 412	29. 187	43. 5	40. 7	. 225	. 764	0. 15	7. 6	N. 21 E.	4. 7	135. 8	....	51. 1	......
November, 1865	12	29. 419	29. 238	38. 8	36. 0	. 180	. 741	0. 02	6. 1	S. 59 W.	2. 4	......	34. 8	....	37. 3
December, 1865	....	......	......	....	....	....	....	....	....	....	....	......	....	....	......
Mean of spring	12	29. 321	29. 160	34. 3	31. 8	. 160	. 757	1. 06	6. 4	N. 5 W.	2. 4	438. 0	....	....	42. 1
Mean of summer	12	29. 397	28. 988	59. 3	55. 8	. 410	. 784	0. 85	4. 5	N. 35 W.	1. 7	253. 3	....	....	185. 1
Mean of autumn	12	29. 373	29. 108	45. 9	43. 1	. 265	. 784	0. 56	6. 6	N. 29 W.	1. 0	170. 0	....	....	94. 8
Mean of winter	12	29. 333	29. 240	21. 8	19. 8	. 093	. 702	0. 55	7. 9	N. 60 W.	3. 0	279. 0	....	....	470. 1
Means of all	12	29. 356	29. 124	40. 3	37. 6	. 232	. 757	3. 02	6. 3	N. 34 W.	1. 9	1140. 3	....	....	792. 1

Meteorological observations at Thunder Bay Island, &c.—Continued.

Date.	Time of observation.	Pressure reduced to 32° Fahr.		Temp., Fahr.		Vapor.		Am't of rain and melted snow, U. S. inches and decimals.	Am't cloudiness. (10=sky entirely overcast, 0=clear sky.	Wind.					
		Total U. S. inches and decimals.	Gaseous, U. S. inches and decimals.	Dry bulb.	Wet bulb.	Elasticity, U. S. inches and decimals.	Humidity. Saturation = 1,000.			Observed direction; from whence.	Observed velocity; miles per hour.	Resolution of direction and velocity, in miles per hour.			
												N.	S.	E.	W.
	P. M.			°	°					°					
December, 1863	11.30	29.403	29.284	27.2	25.2	.119	.750	....	8.0	S. 36 W.	1.5	.....	38.9	....	28.4
January, 1864	11.30	29.298	29.201	21.4	19.7	.097	.732	....	7.3	N. 66 W.	4.2	51.8	....	....	118.6
February, 1864	11.30	29.214	29.114	22.3	20.4	.100	.708	....	7.2	N. 61 W.	4.1	58.0	....	....	105.3
March, 1864	11.30	29.255	29.149	24.5	22.6	.106	.726	....	6.7	N. 12 W.	2.5	77.5	....	....	16.9
April, 1864	11.30	29.358	29.195	34.9	32.9	.163	.798	....	7.2	N. 46 E	1.9	40.6	....	41.2	......
May, 1864	11.30	29.278	29.052	43.8	41.0	.226	.772	....	6.2	N. 6 W.	4.0	123.1	....	....	13.2
June, 1864	11.30	29.416	29.063	55.3	51.6	.353	.741	....	3.4	N. 45 W.	2.3	48.3	....	....	48.9
July, 1864	11.30	29.401	28.919	63.5	60.2	.482	.812	....	4.0	N. 45 W.	0.8	18.6	....	....	18.3
August, 1864	11.30	29.347	28.849	66.1	61.6	.498	.757	....	5.0	N. 33 W.	3.1	78.2	....	....	55.4
September, 1864	11.30	29.369	29.027	54.4	50.9	.342	.788	....	5.2	N. 67 E.	3.0	35.8	....	....	82.7
October, 1864	11.30	29.304	29.076	42.9	40.6	.228	.805	....	8.2	N. 49 W.	2.9	59.3	....	....	68.1
November, 1864	11.30	29.291	29.120	34.9	32.7	.171	.779	....	8.1	S. 76 W.	4.2	.....	30.7	....	121.3
December, 1864	11.30	29.261	29.163	22.3	20.4	.098	.719	....	8.7	N. 63 W.	5.9	82.9	....	....	162.4
January, 1865	11.30	29.369	29.298	17.5	15.5	.071	.656	....	7.6	N. 43 W.	3.5	79.2	....	....	75.0
February, 1865	11.30	29.458	29.375	21.3	19.1	.083	.668	....	8.1	N. 29 W.	1.2	28.4	....	....	16.2
March, 1865	11.30	29.298	29.183	26.6	24.4	.115	.703	....	7.1	N. 28 W.	3.1	86.3	....	....	45.2
April, 1865	11.30	29.383	29.231	34.8	32.2	.152	.737	....	6.1	N. 37 W.	0.9	20.6	....	....	15.4
May, 1865	11.30	29.358	29.152	42.8	39.5	.206	.736	....	4.7	N. 2 E.	3.0	93.2	....	2.5	......
June, 1865	11.30	29.358	29.011	54.1	51.3	.346	.814	....	5.4	S. 19 E.	0.4	.....	10.4	3.6	......
July, 1865	11.30	29.411	29.033	58.8	54.7	.378	.753	...	6.1	N. 25 W.	2.8	78.9	....	....	36.8
August, 1865	11.30	29.454	29.050	59.4	56.2	.404	.764	....	3.2	N. 19 W.	1.3	36.1	....	....	12.2
September, 1865	11.30	29.442	28.992	61.4	58.2	.450	.811	....	4.6	S. 39 W	0.6	.....	14.8	....	12.1
October, 1865	11.30	29.412	29.187	43.6	40.8	.225	.757	....	7.6	N. 18 E.	5.2	155.9	....	50.6	......
November, 1865	11.30	29.424	29.243	38.9	36.1	.180	.739	....	6.3	S. 57 W.	2.6	.....	40.3	....	62.0
December, 1865	....	.....	.....	....	....	....	....	....	....	....	....	.....	....	....	......
Mean of spring	11.30	29.322	29.160	34.6	32.1	.161	.745	....	6.3	N. 7 W	2.4	441.3	....	....	47.0
Mean of summer	11.30	29.398	28.987	59.5	55.9	.410	.773	....	4.5	N. 33 W.	1.7	249.7	....	....	168.0
Mean of autumn	11.30	29.374	29.107	46.0	43.2	.266	.780	....	6.7	N. 61 W.	1.8	165.2	....	....	295.6
Mean of winter	11.30	29.334	29.239	22.0	20.2	.095	.705	....	7.8	N. 63 W.	3.1	261.4	....	....	505.9
Means of all	11.30	29.357	29.123	40.5	37.8	.233	.751	....	6.3	N. 43 W.	2.1	1117.6	....	....	1016.5
December, 1863	11	29.415	29.296	27.9	25.3	.119	.745	0.06	8.0	S. 14 E.	1.3	.....	39.3	9.9	......
January, 1864	11	29.301	29.205	21.5	19.7	.096	.729	0.03	7.1	N. 64 W.	4.5	59.9	....	....	123.8
February, 1864	11	29.217	29.117	22.5	20.5	.100	.708	0.05	7.1	N. 60 W.	4.1	58.2	....	....	102.5
March, 1864	11	29.256	29.150	24.7	22.6	.106	.721	0.02	6.7	North	2.5	77.5	....	0.1	......
April, 1864	11	29.360	29.195	35.1	33.1	.165	.800	....	7.0	N. 37 E.	1.9	46.1	....	35.3	......
May, 1864	11	29.280	29.053	44.0	41.2	.227	.769	0.11	5.7	N. 6 W.	4.1	126.3	....	....	13.0
June, 1864	11	29.414	29.063	55.6	51.7	.351	.746	0.10	3.3	N. 26 W.	2.2	59.5	....	....	29.1
July, 1864	11	29.402	28.919	64.0	60.4	.484	.802	0.03	4.0	N. 45 W.	0.6	13.1	....	....	13.7
August, 1864	11	29.346	28.851	66.5	61.7	.495	.744	0.12	4.9	N. 28 W.	3.4	93.1	....	....	49.9
September, 1864	11	29.374	29.033	54.7	51.0	.341	.780	0.11	5.1	N. 63 E.	3.0	41.4	...	80.8	......
October, 1864	11	29.301	29.071	43.2	40.8	.230	.802	....	8.0	N. 42 W.	2.6	59.8	....	....	53.5
November, 1864	11	29.293	29.121	35.1	32.8	.172	.781	0.20	8.3	S. 77 W.	4.4	.....	28.1	....	127.6
December, 1864	11	29.260	29.161	22.5	20.7	.099	.725	0.07	8.6	N. 67 W.	5.8	70.6	....	....	165.5
January, 1865	11	29.365	29.294	17.8	15.7	.071	.655	0.06	7.7	N. 42 W.	3.4	79.9	....	....	71.0
February, 1865	11	29.461	29.378	21.6	19.3	.083	.665	0.12	4.1	N. 5 E.	0.9	23.8	....	2.0	......
March, 1865	11	29.301	29.186	26.8	24.6	.115	.700	0.03	7.1	N. 29 W.	3.0	82.1	....	....	46.0
April, 1865	11	29.386	29.232	35.2	32.5	.154	.734	0.24	6.2	N. 47 W.	0.9	19.1	....	....	20.8
May, 1865	11	29.359	29.152	43.1	39.8	.206	.729	0.09	5.0	N. 14 E.	3.2	97.3	....	23.2	......
June, 1865	11	29.356	29.006	54.5	51.6	.350	.810	0.31	5.4	S. 44 E	1.9	.....	4.1	3.9	......
July, 1865	11	29.410	29.028	59.3	55.1	.382	.746	0.12	6.1	N. 27 W.	2.7	75.1	....	....	39.0
August, 1865	11	29.453	29.053	60.4	56.3	.400	.756	0.04	3.2	N. 1 E.	1.4	42.8	....	0.5	......
September, 1865	11	29.441	28.989	61.6	58.4	.452	.810	....	4.6	S. 9 W.	1.0	.....	30.6	....	4.9
October, 1865	11	29.411	29.185	43.9	41.0	.226	.755	....	7.7	N. 12 E.	4.9	149.2	....	32.5	......
November, 1865	11	29.426	29.246	39.1	36.2	.180	.734	0.04	6.5	S. 54 W.	2.4	.....	39.2	....	54.9
December, 1865	....	.....	.....	....	....	....	....	....	....	....	....	.....	....	....	......
Mean of spring	11	29.324	29.161	34.8	32.3	.162	.742	0.49	6.3	N. 2 W.	2.4	448.4	....	....	21.2
Mean of summer	11	29.397	28.987	60.0	56.1	.410	.767	0.72	4.5	N. 25 W.	1.6	279.5	....	....	127.3
Mean of autumn	11	29.374	29.107	46.3	43.4	.267	.777	0.24	6.7	N. 41 W.	1.0	152.5	....	....	127.6
Mean of winter	11	29.336	29.242	22.3	20.2	.095	.704	0.39	7.1	N. 59 W.	2.9	253.1	....	....	450.9
Means of all	11	29.358	29.124	40.8	38.0	.233	.747	1.84	6.1	N. 32 W.	1.9	1133.5	....	....	727.0

Meteorological observations at Thunder Bay Island, &c.—Continued.

Date.	Time of observation.	Pressure reduced to 32° Fahr.		Temp., Fahr.		Vapor.		Am't of rain and melted snow, U. S. inches and decimals.	Am't cloudiness, (10=sky entirely overcast, 0=clear sky.)	Wind.					
		Total, U. S. inches and decimals.	Gaseous, U. S. inches and decimals.	Dry bulb.	Wet bulb.	Elasticity, U. S. inches and decimals.	Humidity. Saturation=1.000.			Observed direction; from whence.	Observed velocity; miles per hour.	Resolution of direc and velocity, in m per hour.			
												N.	S.	E.	W.
	P. M.			°	°					°					
December, 1863	10. 30	29. 418	29. 299	27. 3	25. 2	. 119	. 737	....	8. 1	S. 14 E.	1. 5	......	45. 8	11. 9	....
January, 1864	10. 30	29. 301	29. 203	21. 6	19. 8	. 098	. 733	....	7. 3	N. 64 W.	....	55. 6	....	....	[illegible]
February, 1864	10. 30	29. 220	29. 120	22. 5	20. 6	. 100	. 703	....	7. 1	N. 60 W.	4. 0	58. 6	....	....	[illegible]
March, 1864	10. 30	29. 259	29. 153	24. 9	22. 8	. 106	. 718	....	6. 6	N. 7 E.	3. 0	91. 8	....	10. 6	....
April, 1864	10. 30	29. 361	29. 196	35. 3	33. 3	. 165	. 797	....	6. 9	N. 38 E.	2. 1	49. 0	....	38. 0	....
May, 1864	10. 30	29. 279	29. 053	44. 4	41. 3	. 226	. 758	....	6. 2	N. 4 W.	4. 1	126. 4	....	....	[illegible]
June, 1864	10. 30	29. 412	29. 058	56. 0	52. 0	. 354	. 742	....	3. 0	N. 27 W.	1. 7	46. 7	....	....	[illegible]
July, 1864	10. 30	29. 403	28. 915	64. 3	60. 7	. 488	. 800	....	4. 2	North	0. 6	18. 9	....	....	[illegible]
August, 1864	10. 30	29. 345	28. 853	66. 8	61. 7	. 492	. 731	....	5. 0	N. 32 W.	3. 8	98. 7	....	....	[illegible]
September, 1864	10. 30	29. 374	29. 031	54. 9	51. 2	. 343	. 778	....	5. 1	N. 57 E.	3. 1	51. 5	....	77. 8	....
October, 1864	10. 30	29. 305	29. 074	43. 5	41. 1	. 232	. 801	....	7. 9	N. 40 W.	2. 2	51. 1	....	....	[illegible]
November, 1864	10. 30	29. 291	29. 119	35. 2	32. 9	. 172	. 780	....	8. 2	S. 66 W.	3. 6	......	42. 3	....	[illegible]
December, 1864	10. 30	29. 260	29. 160	22. 7	20. 9	. 100	. 726	....	8. 6	N. 69 W.	4. 9	56. 4	....	....	[illegible]
January, 1865	10. 30	29. 367	29. 295	18. 1	16. 0	. 072	. 653	....	7. 5	N. 41 W.	3. 3	77. 3	....	....	[illegible]
February, 1865	10. 30	29. 461	29. 377	21. 5	19. 6	. 084	. 669	....	8. 0	N. 33 E.	1. 2	28. 2	....	18. 3	....
March, 1865	10. 30	29. 302	29. 186	27. 1	24. 8	. 116	. 701	....	7. 3	N. 33 W.	3. 1	80. 2	....	....	[illegible]
April, 1865	10. 30	29. 386	29. 231	35. 5	32. 8	. 155	. 732	....	5. 8	N. 37 W.	1. 0	23. 9	....	....	[illegible]
May, 1865	10. 30	29. 358	29. 151	43. 5	40. 0	. 207	. 720	....	4. 6	N. 18 E.	2. 4	71. 3	....	22. 6	....
June, 1865	10. 30	29. 353	29. 006	54. 9	51. 9	. 347	. 800	....	5. 7	S. 54 E.	3. 1	......	5. 4	7. 4	....
July, 1865	10. 30	29. 407	29. 021	59. 8	55. 3	. 386	. 739	....	6. 4	N. 24 W.	2. 4	67. 1	....	....	[illegible]
August, 1865	10. 30	29. 453	29. 049	60. 8	56. 5	. 404	. 747	....	3. 1	N. 6 E.	1. 6	50. 7	....	5. 3	....
September, 1865	10. 30	29. 439	28. 986	62. 0	58. 6	. 453	. 804	....	4. 8	S. 13 W.	1. 1	......	32. 9	....	[illegible]
October, 1865	10. 30	29. 411	29. 183	44. 1	41. 1	. 228	. 755	....	7. 6	N. 14 E.	4. 5	135. 6	....	34. 9	....
November, 1865	10. 30	29. 426	29. 244	39. 3	36. 3	. 182	. 736	....	6. 8	S. 47 W.	2. 5	......	47. 1	....	[illegible]
December, 1865	.....	......	......	....	....	....	....	....	....	....	....	......	....	....	....
Mean of spring	10. 30	29. 324	29. 162	35. 1	32. 5	. 162	. 738	....	6. 2	N. 1 W.	2. 5	442. 6	....	....	[illegible]
Mean of summer	10. 30	29. 396	28. 983	60. 4	56. 3	. 412	. 760	....	4. 6	N. 22 W.	1. 6	276. 7	....	....	[illegible]
Mean of autumn	10. 30	29. 375	29. 106	46. 5	43. 5	. 268	. 776	....	6. 7	N. 40 W.	0. 8	115. 9	....	....	[illegible]
Mean of winter	10. 30	29. 338	29. 242	22. 4	20. 3	. 095	. 703	....	7. 8	N. 59 W.	2. 5	230. 3	....	....	[illegible]
Means of all	10. 30	29. 358	29. 123	41. 1	38. 1	. 234	. 744	....	6. 3	N. 28 W.	1. 7	1065. 5	....	....	[illegible]
December, 1863	10	29. 417	29. 298	27. 7	25. 4	. 119	. 741	0. 11	7. 9	S. 29 E.	1. 4	......	38. 2	21. 2	....
January, 1864	10	29. 305	29. 207	21. 7	19. 9	. 098	. 731	0. 02	7. 2	N. 65 W.	4. 2	55. 7	....	....	[illegible]
February, 1864	10	29. 220	29. 121	22. 7	20. 7	. 099	. 698	....	7. 0	N. 62 W.	4. 1	55. 7	....	....	[illegible]
March, 1864	10	29. 261	29. 154	25. 1	23. 0	. 107	. 721	0. 02	6. 7	N. 7 E.	2. 9	88. 8	....	11. 1	....
April, 1864	10	29. 361	29. 195	35. 6	33. 5	. 166	. 794	0. 16	6. 9	N. 34 E.	2. 4	60. 8	....	41. 2	....
May, 1864	10	29. 276	29. 051	44. 6	41. 4	. 225	. 749	0. 09	6. 4	N. 3 W.	3. 7	113. 1	....	....	[illegible]
June, 1864	10	29. 411	29. 051	56. 4	52. 3	. 360	. 737	0. 24	2. 9	N. 12 E.	1. 6	46. 1	....	10. 2	....
July, 1864	10	29. 408	28. 918	64. 6	60. 8	. 490	. 793	0. 21	4. 7	N. 7 W.	0. 6	17. 3	....	....	[illegible]
August, 1864	10	29. 342	28. 847	67. 2	62. 0	. 495	. 725	0. 01	5. 4	N. 21 W.	3. 6	103. 3	....		[illegible]
September, 1864	10	29. 374	29. 030	55. 1	51. 3	. 344	. 774	0. 09	5. 2	N. 57 E.	2. 9	47. 6	....	72. 4	....
October, 1864	10	29. 307	29. 074	43. 7	41. 3	. 233	. 800	0. 13	7. 9	N. 41 W.	2. 5	58. 1	....	....	[illegible]
November, 1864	10	29. 295	29. 128	35. 5	33. 2	. 167	. 766	0. 15	8. 1	S. 70 W.	3. 9	......	39. 3	....	[illegible]
December, 1864	10	29. 261	29. 160	23. 0	21. 2	. 101	. 732	0. 19	8. 6	N. 72 W.	4. 4	42. 7	....	....	[illegible]
January, 1865	10	29. 365	29. 292	18. 4	16. 3	. 073	. 654	0. 05	7. 6	N. 51 W.	2. 9	57. 5	....	....	[illegible]
February, 1865	10	29. 464	29. 378	22. 2	19. 9	. 086	. 671	0. 06	8. 0	N. 27 E.	1. 3	33. 0	....	17. 2	....
March, 1865	10	29. 304	29. 189	27. 3	24. 9	. 115	. 694	0. 13	7. 5	N. 35 W.	3. 2	80. 7	....	....	[illegible]
April, 1865	10	29. 387	29. 231	35. 9	33. 1	. 156	. 729	0. 14	6. 2	N. 29 W.	0. 9	24. 4	....	....	[illegible]
May, 1865	10	29. 356	29. 148	43. 9	40. 3	. 208	. 716	0. 07	4. 6	N. 23 E.	2. 6	73. 7	....	30. 8	....
June, 1865	10	29. 352	29. 004	55. 5	52. 3	. 348	. 790	0. 14	5. 8	N. 34 E.	3. 7	9. 2	....	6. 2	....
July, 1865	10	29. 407	29. 021	59. 8	55. 3	. 386	. 739	0. 14	6. 4	N. 24 W.	2. 4	67. 1	....	....	[illegible]
August, 1865	10	29. 452	29. 046	61. 2	56. 8	. 406	. 741	0. 04	3. 0	N. 7 E.	1. 6	49. 2	....	6. 0	....
September, 1865	10	29. 436	28. 981	62. 3	58. 7	. 455	. 798	0. 04	4. 8	South	1. 1	......	33. 9	0. 9	....
October, 1865	10	29. 410	29. 182	44. 3	41. 2	. 228	. 747	0. 10	7. 3	N. 17 E.	4. 3	128. 2	....	40. 1	....
November, 1865	10	29. 428	29. 248	39. 3	36. 3	. 180	. 731	....	6. 8	S. 72 W.	2. 1	......	17. 4	....	[illegible]
December, 1865	.....	......	......	....	....	....	....	....	....	....	....	......	....	....	....
Mean of spring	10	29. 324	29. 161	35. 4	32. 7	. 163	. 734	0. 61	6. 4	N. 1 E.	2. 4	441. 5	....	5. 6	....
Mean of summer	10	29. 395	28. 981	60. 8	56. 6	. 414	. 754	0. 78	4. 7	N. 11 W.	1. 6	292. 2	....	....	[illegible]
Mean of autumn	10	29. 375	29. 107	46. 7	43. 7	. 268	. 769	0. 51	6. 7	N. 37 W.	1. 0	143. 3	....	....	[illegible]
Mean of winter	10	29. 339	29. 243	22. 6	20. 6	. 096	. 704	0. 43	7. 7	N. 62 W.	2. 4	206. 4	....	....	[illegible]
Means of all	10	29. 358	29. 123	41. 3	38. 4	. 235	. 740	2. 33	6. 4	N. 25 W.	1. 7	1083. 4	....	...	[illegible]

Meteorological observations at Thunder Bay Island, &c.—Continued.

Date.	Time of observation.	Pressure reduced to 32° Fahr.		Temp., Fahr.		Vapor.		Am't. of rain and melted snow, U. S. inches and decimals.	Am't cloudiness. (10=sky entirely overcast, 0=clear sky.)	Wind.					
		Total U. S. inches and decimals.	Gaseous, U. S. inches and decimals.	Dry bulb.	Wet bulb.	Elasticity, U. S. inches and decimals.	Humidity. Saturation=1.000.			Observed direction; from whence.	Observed velocity; miles per hour.	Resolution of direction and velocity, in miles per hour.			
												N.	S.	E.	W.
	P. M.			°	°					°					
ecember, 1863	9.30	29.421	29.302	27.5	25.3	.119	.731	....	7.6	S. 31 E.	1.5	......	40.1	24.9	......
anuary, 1864	9.30	29.311	29.213	21.7	19.9	.098	.734	....	7.2	N. 64 W.	4.2	57.7	....	....	118.3
ebruary, 1864	9.30	29.220	29.119	22.9	20.9	.101	.698	....	6.9	N. 57 W.	3.5	55.4	....	....	85.7
arch, 1864	9.30	29.262	29.156	25.1	23.0	.106	.720	....	6.9	N. 9 E.	2.9	88.1	....	13.8	......
pril, 1864	9.30	29.356	29.190	35.9	33.7	.166	.783	....	6.8	N. 32 E.	2.6	67.2	....	41.2	......
ay, 1864	9.30	29.272	29.045	44.9	41.7	.227	.748	....	6.9	N. 4 W.	3.8	111.1	....	....	8.6
une, 1864	9.30	29.410	29.052	57.0	52.6	.358	.724	....	3.4	N. 6 E.	1.1	32.7	....	3.7	......
uly, 1864	9.30	29.405	28.918	64.8	60.9	.486	.783	....	5.2	N. 8 W.	0.5	16.0	....	....	2.6
ugust, 1864	9.30	29.340	28.842	67.7	62.2	.498	.715	....	5.5	N. 22 W.	3.4	100.8	....	....	40.3
eptember, 1864	9.30	29.372	29.027	55.0	51.5	.345	.770	....	5.2	N. 57 E.	2.7	43.9	....	68.6	......
ctober, 1864	9.30	29.308	29.072	44.1	41.6	.236	.799	....	7.9	N. 44 W.	1.7	39.3	....	....	37.5
ovember, 1864	9.30	29.296	29 129	35.6	33.2	.167	.766	....	7.9	S. 67 W	3.6	......	42.8	....	100.2
ecember, 1864	9.30	29.261	29.159	23.2	21.4	.102	.732	....	8.6	N. 73 W.	4.3	38.1	....	....	128.2
anuary, 1865	9.30	29.365	29.292	18.5	16.3	.073	.653	....	7.6	N. 57 W.	2.3	39.6	....	....	59.6
ebruary, 1865	9.30	29.461	29.375	22.3	20.0	.086	.668	....	8.0	N. 24 E.	1.5	38.5	....	17.0	......
arch, 1865	9.30	29.304	29.187	27.5	25.2	.117	.700	....	7.8	N. 31 W.	3.6	94.9	....	....	57.7
pril, 1865	9.30	29.388	29.230	36.2	33.4	.157	.721	....	6.0	N. 45 W.	1.1	23.0	....	....	23.4
ay, 1865	9.30	29.353	29.144	44.4	40.6	.208	.702	....	4.7	N. 28 E.	2.4	65.8	....	34.6	......
une, 1865	9.30	29.350	28.993	55.9	52.6	.357	.787	....	6.0	S. 31 E.	2.7	......	6.8	4.1	......
uly, 1865	9.30	29.401	29.007	60.8	56.2	.394	.731	....	6.7	N. 13 W.	2.2	68.0	....	....	15.9
ugust, 1865	9.30	29.450	29.040	61.7	57.1	.410	.733	....	2.8	N. 19 E.	1.8	52.6	....	18.8	......
eptember, 1865	9.30	29.436	28.977	62.6	59.0	.459	.796	....	5.0	S. 3 E.	1.2	......	37.7	2.1	......
ctober, 1865	9.30	29.410	29.182	44.4	41.3	.228	.741	....	7.3	N. 17 E.	3.9	117.1	....	35.4	......
ovember, 1865	9.30	29.429	29.248	39.4	36.4	.180	.728	....	6.6	S. 57 W.	2.4	......	36.0	....	56.2
ecember, 1865	....	......	......	....	....	....	....	....	....	....	....	......	....	....	......
ean of spring	9.30	29.322	29.159	35.7	32.9	.163	.729	....	6.5	North ..	2.4	450.1	....	....	......
ean of summer	9.30	29.393	28.975	61.3	56.9	.417	.745	....	4.9	N. 8 W.	1.4	263.3	....	....	32.2
ean of autumn	9.30	29.375	29.106	46.8	43.8	.269	.767	....	6.6	N. 45 W.	0.7	83.8	....	....	87.8
ean of winter	9.30	29.340	29.243	22.7	20.6	.096	.703	....	7.6	N. 62 W.	2.2	189.2	....	....	349.9
Means of all	9.30	29.358	29.121	41.6	38.5	.236	.736	....	6.4	N. 25 W.	1.4	986.4	....	....	469.9
ecember, 1863	9	29.418	29.298	27.5	25.4	.120	.743	0.13	7.7	S. 43 E.	2.4	......	54.0	51.5	......
anuary, 1864	9	29.314	29.216	21.8	20.0	.098	.732	0.03	7.2	N. 65 W.	4.4	58.9	....	....	124.9
ebruary, 1864	9	29.220	29.117	23.3	21.3	.103	.702	....	6.6	N. 56 W.	3.4	56.3	....	....	82.5
arch, 1864	9	29.263	29.156	25.2	23.1	.108	.722	0.04	6.6	N. 11 E.	2.6	79.6	....	15.6	......
pril, 1864	9	29.359	29.192	36.3	33.9	.167	.780	0.18	6.6	N. 32 E.	2.4	61.1	....	38.2	......
ay, 1864	9	29.267	29.040	45.2	41.9	.227	.739	0.18	7.0	North ..	3.9	120.9	....	0.3	......
une, 1864	9	29.411	29.054	57.5	52.9	.357	.710	0.20	4.1	N. 52 E.	0.7	14.8	....	18.2	......
uly, 1864	9	29.400	28.913	65.3	61.1	.487	.772	0.15	5.9	N. 23 W.	0.6	17.5	....	....	7.1
ugust, 1864	9	29.337	28.835	68.2	62.6	.502	.711	0.02	5.7	N. 25 W.	3.1	86.7	....	....	41.4
eptember, 1864	9	29.370	29.025	55.2	51.6	.345	.766	0.04	5.3	N. 49 E.	2.8	55.9	....	63.9	......
ctober, 1864	9	29.304	29.067	44.3	41.8	.237	.796	0.10	7.9	N. 42 W.	1.7	38.1	....	....	34.5
ovember, 1864	9	29.295	29.128	35.7	33.3	.167	.764	0.15	8.0	S. 64 W.	3.7	......	48.0	....	100.0
ecember, 1864	9	29.262	29.160	23.4	21.5	.102	.727	0.27	8.5	N. 72 W.	4.2	41.2	....	....	123.0
anuary, 1865	9	29.363	29.289	18.8	16.6	.074	.655	0.05	7.7	N. 59 W.	2.4	37.7	....	....	62.1
ebruary, 1865	9	29.466	29.380	22.5	20.1	.086	.661	0.16	7.9	N. 20 E.	1.7	45.4	....	16.4	......
arch, 1865	9	29.303	29.187	27.7	25.3	.116	.693	0.08	7.9	N. 30 W.	3.7	100.5	....	....	57.7
pril, 1865	9	29.387	29.229	36.6	33.6	.158	.717	0.09	6.0	N. 48 W.	1.3	26.6	....	....	29.2
ay, 1865	9	29.350	29.139	44.9	41.0	.211	.698	0.12	5.1	N. 27 E.	2.2	59.4	....	30.3	......
une, 1865	9	29.347	28.988	56.3	52.8	.359	.780	0.37	6.1	S. 14 W.	0.2	......	5.4	....	1.4
uly, 1865	9	29.398	29.004	61.2	56.4	.394	.721	0.08	6.8	N. 13 W.	2.2	68.3	....	....	15.9
ugust, 1865	9	29.449	29.035	62.3	57.4	.414	.726	0.08	2.9	N. 18 E.	1.9	57.2	....	18.3	......
eptember, 1865	9	29.435	28.971	63.0	59.4	.464	.795	0.04	5.0	S. 9 E.	1.5	......	45.7	7.9	......
ctober, 1865	9	29.409	29.176	44.6	41.5	.233	.738	....	6.9	N. 15 E.	3.8	114.7	....	31.4	......
ovember, 1865	9	29.431	29.249	39.5	36.5	.181	.727	0.04	6.6	S. 66 W.	2.2	......	24.4	....	56.0
ecember, 1865	....	......	......	....	....	....	....	....	....	....	....	......	....	....	......
ean of spring	9	29.321	29.157	36.0	33.1	.164	.725	0.69	6.5	North ..	2.4	448.1	....	....	2.5
ean of summer	9	29.390	28.971	61.8	57.2	.419	.737	0.90	5.2	N. 9 W.	1.3	239.1	....	....	29.3
ean of autumn	9	29.376	29.103	47.0	44.0	.271	.764	0.37	6.6	N. 45 W.	0.7	90.6	....	....	87.3
ean of winter	9	29.340	29.243	22.9	20.8	.097	.703	0.64	7.6	N. 61 W.	2.1	185.5	....	....	324.6
Means of all	9	29.357	29.119	41.9	38.8	.238	.732	2.60	6.5	N. 25 W.	1.4	963.3	....	....	443.7

Meteorological observations at Thunder Bay Island, &c.—Continued.

Date.	Time of observation.	Pressure reduced to 32° Fahr.		Temp., Fahr.		Vapor.		Am't of rain and melted snow, U. S. inches and decimals.	Am't cloudiness. (10=sky entirely overcast, 0=clear sky.)	Wind.				
		Total, U. S. inches and decimals.	Gaseous, U. S. inches and decimals.	Dry bulb.	Wet bulb.	Elasticity, U. S. inches and decimals.	Humidity. Saturation=1.000.			Observed direction; from whence.	Observed velocity; miles per hour.	Resolution of direction and velocity, in miles per hour. N.	S.	E.
	P.M.			°	°					°				
December, 1863	8.30	29.422	29.300	27.6	25.5	.122	.737	....	7.7	S. 45 E.	2.0	......	43.5	42.9
January, 1864	8.30	29.315	29.216	21.8	20.0	.099	.734	....	7.3	N. 71 W.	7.2	39.2	...	....
February, 1864	8.30	29.219	29.116	23.5	21.5	.103	.696	....	6.6	N. 54 W.	3.5	59.2	....	....
March, 1864	8.30	29.264	29.156	25.5	23.3	.108	.717	....	6.2	N. 7 E.	2.9	89.8	....	10.9
April, 1864	8.30	29.360	29.192	36.7	34.3	.168	.772	....	7.3	N. 29 E.	2.4	62.7	....	35.1
May, 1864	8.30	29.262	29.036	45.6	42.0	.226	.725	....	7.2	N. 1 W.	4.0	124.6	...	....
June, 1864	8.30	29.410	29.051	58.3	53.3	.359	.695	....	4.6	N. 42 E.	0.8	17.0	....	15.8
July, 1864	8.20	29.395	28.905	65.8	61.4	.490	.764	....	6.3	N. 82 E.	0.6	2.6	....	12.8
August, 1864	8.08	29.335	28.829	68.8	62.9	.506	.703	....	6.0	N. 22 W.	3.1	89.6	....	....
September, 1864	8.30	29.369	29.027	55.5	51.6	.342	.756	....	5.3	N. 35 E.	2.7	65.8	....	45.3
October, 1864	8.30	29.305	29.067	44.8	42.0	.237	.792	....	7.8	N. 43 W.	1.5	34.1	....	....
November, 1864	8.30	29.293	29.125	35.9	33.5	.168	.758	....	8.1	S. 65 W.	3.6	......	44.1	....
December, 1864	8.30	29.261	29.157	23.7	21.8	.104	.732	....	8.7	N. 70 W.	4.2	44.2	....	....
January, 1865	8.30	29.362	29.287	19.0	16.8	.075	.655	....	7.9	N. 60 W.	2.6	41.1	....	....
February, 1865	8.30	29.467	29.382	22.2	20.1	.085	.653	....	8.0	N. 12 E.	1.8	49.9	....	10.7
March, 1865	8.30	29.303	29.186	27.9	25.5	.117	.694	....	7.8	N. 30 W.	3.8	102.5	...	....
April, 1865	8.30	29.388	29.230	36.8	33.8	.158	.709	....	6.1	N. 19 E.	0.9	24.3	....	8.3
May, 1865	8.30	29.349	29.136	45.6	41.4	.213	.686	....	5.7	N. 19 E.	2.0	58.1	....	20.5
June, 1865	8.30	29.344	28.983	56.6	53.0	.360	.775	....	6.8	N. 47 E.	3.6	7.4	....	7.9
July, 1865	8.30	29.396	28.999	61.8	56.7	.397	.713	....	6.6	N. 17 W.	1.9	56.8	....	....
August, 1865	8.30	29.448	29.028	62.9	57.9	.420	.721	....	3.4	N. 15 E.	1.7	51.9	....	14.2
September, 1865	8.30	29.433	28.965	63.5	59.7	.468	.788	....	5.2	S. 8 E	1.9	......	56.1	8.9
October, 1865	8.30	29.407	29.175	45.0	41.8	.232	.735	....	7.1	N. 16 E.	3.7	111.6	....	32.5
November, 1865	8.30	29.432	29.251	39.6	36.5	.181	.723	....	6.8	S. 67 W.	2.4	......	25.9	....
December, 1865	....	......	......	....	....	....	....	....	....	....	....	......	....	....
Mean of spring	8.30	29.321	29.156	36.3	33.4	.165	.717	....	6.7	N. 15 E.	2.6	472.0	....	13.4
Mean of summer	8.30	29.388	28.966	62.4	57.5	.422	.728	....	5.6	North	1.2	225.3	....	1.3
Mean of autumn	8.30	29.373	29.102	47.4	44.2	.271	.759	....	6.7	N. 50 W.	0.8	85.4	....	....
Mean of winter	8.30	29.341	29.243	22.9	20.9	.098	.701	....	7.7	N. 38 W.	2.1	190.1	....	....
Means of all	8.30	29.356	29.117	42.2	39.0	.239	.726	....	6.7	N. 25 W.	1.4	972.8	....	....
December, 1863	8	29.423	29.304	27.6	25.4	.118	.730	0.09	7.6	S. 44 E.	1.6	......	35.7	34.1
January, 1864	8	29.321	29.222	21.9	20.1	.099	.729	0.03	7.5	N. 61 W.	3.8	56.1	....	....
February, 1864	8	29.219	29.114	23.8	21.8	.105	.694	0.04	6.6	N. 57 W.	3.1	49.2	....	....
March, 1864	8	29.263	29.155	25.6	23.4	.108	.711	0.04	6.1	N. 10 E.	3.0	90.1	....	15.5
April, 1864	8	29.357	29.189	37.1	34.5	.168	.762	0.21	7.2	N. 22 E.	2.2	61.2	....	21.8
May, 1864	8	29.257	29.030	46.3	42.4	.227	.710	0.22	7.5	N. 1 W	4.0	123.9	....	...
June, 1864	8	29.410	29.044	59.2	54.0	.366	.686	0.09	5.0	N. 27 E.	0.9	23.9	...	12.0
July, 1864	8	29.393	28.900	66.4	61.7	.493	.752	0.04	6.6	S. 88 E.	0.9	......	1.0	27.0
August, 1864	8	29.334	28.826	69.5	63.2	.508	.688	0.09	6.7	N. 29 W.	2.6	72.9	....	....
September, 1864	8	29.364	29.021	55.7	51.8	.343	.748	0.03	5.4	N. 44 E.	2.2	48.0	....	47.0
October, 1864	8	29.305	29.067	44.7	42.1	.238	.786	0.06	7.8	N. 51 W.	1.3	26.5	....	....
November, 1864	8	29.293	29.124	36.0	33.6	.169	.755	0.03	8.1	S. 68 W.	3.2	......	35.2	....
December, 1864	8	29.261	29.156	23.8	21.9	.104	.727	0.19	8.8	N. 74 W	3.9	34.2	...	....
January, 1865	8	29.360	29.284	19.2	17.0	.076	.659	0.06	8.1	N. 58 W.	2.9	47.2	...	...
February, 1865	8	29.468	29.382	22.7	20.2	.086	.655	0.11	8.1	N. 7 E.	1.9	53.2	...	6.3
March, 1865	8	29.301	29.183	28.3	25.8	.118	.690	0.09	7.6	N. 28 W.	4.1	112.1	....	....
April, 1865	8	29.386	29.229	37.3	33.9	.157	.695	0.10	6.0	N. 57 W.	1.0	16.1	....	...
May, 1865	8	29.336	29.122	46.2	41.8	.214	.676	0.08	6.1	N. 25 E.	1.8	51.7	....	23.7
June, 1865	8	29.338	28.978	57.0	53.2	.359	.764	0.27	7.6	S. 24 E.	0.6	......	16.8	7.3
July, 1865	8	29.393	28.994	62.3	57.0	.399	.703	0.02	6.6	N. 12 W.	1.6	49.1	....	....
August, 1865	8	29.447	29.022	63.5	58.3	.425	.710	0.09	3.8	N. 11 E.	1.7	51.1	....	9.8
September, 1865	8	29.432	28.960	63.9	59.9	.472	.784	....	5.3	S. 11 E.	1.8	......	53.0	10.0
October, 1865	8	29.407	29.173	45.3	42.1	.234	.731	0.10	7.3	N. 1 W.	2.8	88.2	....	....
November, 1865	8	29.434	29.253	39.8	36.6	.181	.718	0.05	6.7	S. 78 W.	2.0	......	11.9	....
December, 1865	....	......	......	....	....	....	....	....	....	....	....	......	....	....
Mean of spring	8	29.317	29.151	36.8	33.6	.165	.707	0.74	6.7	North	2.5	455.1	....	....
Mean of summer	8	29.386	28.961	63.0	7.9	.425	.717	0.60	6.0	N. 2 E.	1.0	178.2	....	6.6
Mean of autumn	8	29.372	29.100	47.6	44.3	.273	.754	0.27	6.8	N. 67 W.	0.8	62.6	....	....
Mean of winter	8	29.342	29.244	23.2	21.1	.098	.699	0.52	7.8	N. 58 W	2.1	204.2	....	....
Means of all	8	29.354	29.114	42.6	39.2	.240	.719	2.13	6.8	N. 26 W.	1.3	900.1	....	....

Meteorological observations at Thunder Bay Island, &c.—Continued.

Date.	Time of observation.	Pressure reduced to 32° Fahr.		Temp., Fahr.		Vapor.		Am't of rain and melted snow, U. S. inches and decimals.	Am't cloudiness, (10=sky entirely overcast, 0=clear sky.)	Wind.					
		Total, U. S. inches and decimals.	Gaseous, U. S. inches and decimals.	Dry bulb.	Wet bulb.	Elasticity, U. S. inches and decimals.	Humidity. Saturation=1.000.			Observed direction; from whence.	Observed velocity; miles per hour.	Resolution of direction and velocity, in miles per hour.			
												N.	S.	E.	W.
	P. M.			°	°					°					
December, 1863	7.30	29.428	29.311	27.5	25.4	.117	.733	....	7.9	S. 63 E.	1.4	......	20.3	40.0	......
January, 1864	7.30	29.321	29.223	21.9	20.1	.098	.712	....	7.7	N. 60 W.	3.3	52.1	....	....	90.0
February, 1864	7.30	29.217	29.113	23.9	21.8	.104	.691	....	6.8	N. 57 W.	3.0	47.9	....	....	73.4
March, 1864	7.30	29.259	29.150	25.9	23.6	.109	.715	....	6.3	N. 15 E.	2.5	74.2	....	20.2	......
April, 1864	7.30	99.357	29.187	37.6	35.0	.170	.758	....	7.0	N. 30 E.	1.9	48.9	....	28.2	......
May, 1864	7.30	29.254	29.025	46.9	42.9	.229	.704	....	7.5	North ..	3.4	107.3	....	0.4	......
June, 1864	7.30	29.409	29.041	60.3	54.5	.368	.667	....	4.9	N. 31 E.	1.0	25.5	....	15.4	......
July, 1864	7.30	29.392	28.899	67.2	62.0	.493	.733	....	6.9	N. 80 E	1.2	6.1	....	35.0	......
August, 1864	7.30	29.333	28.820	70.2	63.6	.513	.679	....	7.0	N. 19 W.	2.4	72.6	....	....	24.9
September, 1864	7.30	29.369	29.026	56.2	52.0	.343	.735	....	5.7	N. 39 E.	2.5	57.9	....	46.1	......
October, 1864	7.30	29.305	29.066	45.0	42.2	.239	.780	....	7.9	N. 67 W.	0.7	8.2	....	....	19.4
November, 1864	7.30	29.292	29.122	36.1	33.7	.170	.757	....	8.2	S. 70 W.	2.9	......	29.9	....	82.8
December, 1864	7.30	29.260	29.156	23.5	21.9	.104	.725	....	8.8	N. 77 W.	3.8	25.9	....	....	115.4
January, 1865	7.30	29.358	29.282	19.3	17.2	.076	.655	....	7.9	N. 56 W.	3.1	53.5	....	....	79.2
February, 1865	7.30	29.467	29.380	22.9	20.5	.087	.657	....	8.2	N. 4 E..	1.6	46.2	....	3.6	......
March, 1865	7.30	29.296	29.178	28.6	26.1	.118	.682	....	7.9	N. 28 W.	4.3	117.5	....	....	63.1
April, 1865	7.30	29.384	29.226	37.7	34.3	.158	.689	....	6.0	N. 50 W.	1.0	18.3	....	....	22.1
May, 1865	7.30	29.344	29.128	46.8	42.2	.215	.665	....	6.5	N. 24 E.	1.1	29.9	....	13.4	......
June, 1865	7.30	29.340	28.976	57.6	53.6	.364	.753	....	7.3	S. 28 E.	1.3	......	33.9	18.3	......
July, 1865	7.30	29.390	28.989	63.0	57.4	.401	.685	....	6.8	N. 13 W.	1.5	44.9	....	....	10.4
August, 1865	7.30	29.446	29.016	64.0	58.7	.430	.712	....	4.1	N. 12 E.	1.7	52.9	....	11.7	......
September, 1865	7.30	29.430	28.951	64.4	60.3	.479	.778	....	5.7	S. 8 E...	1.8	......	55.6	7.0	......
October, 1865	7.30	29.406	29.170	45.9	42.4	.236	.726	....	7.5	North ..	3.0	92.5	....	....	0.1
November, 1865	7.30	29.424	29.241	40.0	36.7	.182	.718	....	6.9	S. 69 W.	2.0	......	19.1	....	50.1
December, 1865	....	......	......	....	....	....	....	....	....	....	....	......	....	....	......
Mean of spring	7.30	29.316	29.149	37.2	34.0	.166	.702	....	6.9	N. 2 W.	2.7	496.1	....	....	23.0
Mean of summer	7.30	29.385	28.957	63.7	58.3	.428	.705	....	6.2	N. 12 E.	0.9	168.1	....	47.1	......
Mean of autumn	7.30	29.371	29.096	47.9	44.5	.275	.749	....	7.0	N. 59 W.	0.6	54.0	....	....	99.3
Mean of winter	7.30	29.342	29.244	23.2	21.1	.098	.695	....	7.9	N. 57 W.	2.0	205.3	....	....	314.4
Means of all	7.30	29.353	29.111	43.0	39.5	.242	.713	....	7.0	N. 21 W.	1.4	923.5	....	....	389.6
December, 1863	7	29.432	29.315	27.5	25.3	.117	.736	0.09	7.9	S. 73 E.	1.4	......	13.3	42.0	......
January, 1864	7	29.317	29.217	22.1	20.2	.100	.729	....	8.0	N. 60 W.	3.1	49.0	....	....	84.5
February, 1864	7	29.220	29.115	24.1	22.0	.105	.695	0.11	7.1	N. 52 W.	3.1	57.6	....	....	72.7
March, 1864	7	29.256	29.147	26.3	23.9	.109	.698	0.08	6.5	N. 16 E.	2.4	71.2	....	19.9	......
April, 1864	7	29.356	29.184	28.1	35.4	.172	.755	0.13	7.2	N. 34 E.	2.1	50.9	....	24.7	......
May, 1864	7	29.250	29.017	47.8	43.5	.233	.690	0.04	7.4	North ..	2.9	92.2	....	....	0.5
June, 1864	7	29.408	29.035	60.8	55.3	.373	.652	....	5.2	N. 35 E.	0.5	13.1	....	9.7	......
July, 1864	7	29.393	28.895	68.1	62.6	.499	.720	0.03	6.8	S. 62 E.	1.1	......	16.0	31.1	......
August, 1864	7	29.332	28.818	70.8	63.9	.514	.666	0.12	7.5	N. 17 W.	2.3	69.7	....	....	21.6
September, 1864	7	29.363	29.021	56.7	52.3	.342	.719	0.03	5.9	N. 36 E.	2.4	58.6	....	42.4	......
October, 1864	7	29.304	29.065	45.2	42.4	.239	.770	0.14	8.0	N. 48 W.	0.9	19.2	....	....	21.1
November, 1864	7	29.293	29.125	36.1	33.6	.168	.754	0.11	8.3	S. 75 W.	1.6	......	12.0	....	46.7
December, 1864	7	29.258	29.153	24.0	22.1	.105	.725	0.20	8.9	N. 69 W.	3.5	38.1	....	....	100.2
January, 1865	7	29.355	29.279	19.4	17.2	.076	.649	0.07	7.8	N. 57 W.	3.1	52.5	....	....	79.5
February, 1865	7	29.466	29.379	23.3	20.8	.087	.646	0.13	8.4	N. 9 W.	1.0	28.2	....	....	4.6
March, 1865	7	29.292	29.173	29.1	26.4	.119	.674	0.16	8.2	N. 29 W.	4.3	115.1	....	....	64.0
April, 1865	7	29.379	29.219	38.3	34.8	.160	.681	0.02	6.3	N. 59 W.	1.1	17.1	....	....	28.5
May, 1865	7	29.341	29.125	47.6	42.6	.216	.648	0.05	6.5	N. 41 E.	0.9	19.9	....	17.6	......
June, 1865	7	29.338	28.971	58.3	54.0	.366	.743	0.28	7.8	S. 32 E.	1.9	......	49.0	30.6	......
July, 1865	7	29.389	28.982	63.8	57.9	.407	.682	0.06	6.7	N. 13 W.	1.6	48.9	....	...	11.3
August, 1865	7	29.445	29.012	64.7	59.4	.433	.698	....	4.4	N. 16 E.	1.9	55.3	....	15.5	......
September, 1865	7	29.428	28.944	64.8	60.7	.484	.773	....	6.2	S. 2 E..	2.1	......	64.0	2.7	......
October, 1865	7	29.402	29.163	46.4	43.0	.239	.725	....	7.4	North ..	3.5	109.2	....	0.2	......
November, 1865	7	29.433	29.250	40.2	36.9	.183	.713	0.05	6.9	S. 72 W.	1.7	......	14.6	....	45.4
December, 1865	....	......	......	....	....	....	....	....	....	....	....	......	....	....	......
Mean of spring	7	29.312	29.144	37.9	34.4	.168	.691	0.48	7.0	N. 3 W.	2.0	366.4	....	....	20.3
Mean of summer	7	29.384	28.952	64.4	58.8	.432	.693	0.49	6.4	N. 23 E.	0.8	122.0	....	53.0	......
Mean of autumn	7	29.370	29.095	48.2	44.8	.276	.742	0.33	7.1	N. 31 W.	0.6	96.4	....	....	67.9
Mean of winter	7	29.341	29.244	23.4	21.3	.098	.697	0.60	8.0	N. 55 W.	2.1	212.1	....	....	299.5
Means of all	7	29.352	29.109	43.5	39.8	.243	.706	1.90	7.1	N. 24 W.	1.2	796.9	....	....	334.7

Meteorological observations at Thunder Bay Island, &c.—Continued.

Date.	Time of observation.	Pressure reduced to 32° Fahr.		Temp., Fahr.		Vapor.		Am't of rain and melted snow, U. S. inches and decimals.	Am't of cloudiness. (10 = sky entirely overcast, 0 = clear sky.)	Wind.					
		Total, U. S. inches and decimals.	Gaseous, U. S. inches and decimals.	Dry bulb.	Wet bulb.	Elasticity, U. S. inches and decimals.	Humidity. Saturation = 1.000.			Observed direction; from whence.	Observed velocity; miles per hour.	Resolution of direction and velocity, in miles per hour.			
												N.	S.	E.	W.
	P. M.			°	°					°					
December, 1863	6.30	29.434	29.317	27.6	25.4	.117	.735	....	8.1	S. 85 E	1.9	......	5.1	59.3	......
January, 1864	6.30	29.313	29.215	22.2	20.3	.098	.713	....	7.8	N. 63 W.	2.6	36.0	....	....	71.4
February, 1864	6.30	29.219	29.113	24.3	22.2	.106	.695	....	7.5	N. 55 W.	3.1	52.5	....	....	74.5
March, 1864	6.30	29.254	29.144	26.9	24.4	.110	.688	....	6.4	N. 18 E.	2.4	69.9	....	22.5	......
April, 1864	6.30	29.360	29.186	38.6	35.8	.174	.745	....	7.4	N. 36 E.	2.4	57.3	....	41.5	......
May, 1864	6.30	29.252	29.014	48.7	44.2	.238	.685	....	7.4	N. 20 E.	1.4	41.9	....	15.0	......
June, 1864	6.30	29.412	29.031	62.4	56.0	.381	.643	....	4.2	N. 45 E	0.3	6.6	....	7.3	......
July, 1864	6.30	29.388	28.877	69.0	63.1	.506	.710	....	7.0	S. 68 E.	1.1	......	12.6	31.4	......
August, 1864	6.30	29.328	28.805	71.7	64.3	.523	.650	....	7.1	N. 13 W.	2.2	65.6	....	....	15.4
September, 1864	6.30	29.356	29.011	57.3	52.6	.345	.713	....	6.6	N. 41 E	2.4	54.9	....	47.8	......
October, 1864	6.30	29.305	29.066	45.6	42.6	.239	.759	....	8.1	N. 55 W.	0.9	16.8	....	....	23.8
November, 1864	6.30	29.290	29.122	36.1	33.6	.168	.751	....	8.4	S. 80 W.	1.8	......	9.4	....	34.7
December, 1864	6.30	29.255	29.151	24.1	22.1	104	.718	....	9.1	N. 73 W.	3.7	34.9	....	....	110.9
January, 1865	6.30	29.351	29.274	19.7	17.4	.077	.642	....	7.9	N. 56 W.	3.2	54.5	....	....	82.6
February, 1865	6.30	29.462	29.374	23.6	21.1	.088	.655	...	8.6	N. 23 W.	1.0	26.9	....	....	11.1
March, 1865	6.30	29.288	29.167	29.6	26.9	.120	.677	....	8.2	N. 29 W.	4.2	114.5	....	....	62.4
April, 1865	6.30	29.377	29.214	38.9	35.3	.162	.675	....	6.4	N. 79 W.	1.1	6.4	....	....	33.4
May, 1865	6.30	29.342	29.125	48.2	43.0	.217	.639	....	6.4	N. 51 E.	0.8	16.7	...	20.3	......
June, 1865	6.30	29.337	28.966	59.0	54.5	.371	.734	....	7.6	S. 55 E.	2.3	......	40.4	57.0	......
July, 1865	6.30	29.389	28.976	64.5	58.4	.413	.675	....	6.6	N. 8 W.	2.0	59.6	....	....	8.9
August, 1865	6.30	29.443	29.006	65.2	59.6	.438	.688	....	4.3	N. 11 E.	1.3	38.2	....	7.7	......
September, 1865	6.30	29.426	28.935	65.6	61.2	.491	.766	....	6.4	S. 1 E..	1.9	......	59.2	1.3	......
October, 1865	6.30	29.400	29.151	46.9	43.4	.246	.723	....	7.6	N. 7 E..	3.2	97.9	....	11.8	......
November, 1865	6.30	29.428	29.245	40.5	37.1	.183	.707	....	7.0	S. 79 W.	1.5	......	7.2	....	40.6
December, 1865	....	......	......	....	....	....	....	....	....	....	....	......	....	....	......
Mean of spring	6.30	29.312	29.142	38.5	34.9	.170	.685	....	7.0	N. 1 E..	1.7	306.7	....	3.5	......
Mean of summer	6.30	29.363	28.943	65.3	59.3	.439	.683	....	6.1	N. 34 E.	0.8	117.0	....	79.1	......
Mean of autumn	6.30	29.367	29.089	48.7	45.1	.279	.736	....	7.3	N. 22 W.	0.5	93.8	....	....	38.2
Mean of winter	6.30	29.339	29.241	23.6	21.4	.098	.693	....	8.2	N. 55 W.	1.9	199.7	....	....	291.2
Means of all	6.30	29.349	29.104	44.0	40.2	.246	.699	....	7.1	N. 17 W.	1.0	717.2	....	....	246.8
December, 1863	6	29.424	29.312	27.7	25.5	.112	.734	0.14	8.4	S. 84 E.	1.7	......	5.0	52.4	......
January, 1864	6	29.308	29.210	22.4	20.5	.098	.712	0.05	7.5	N. 63 W.	2.6	36.0	....	....	71.5
February, 1864	6	29.212	29.106	24.5	22.4	.106	.695	0.12	7.6	N. 54 W.	3.2	55.6	....	....	76.3
March, 1864	6	29.254	29.143	27.7	24.9	.110	.675	0.01	6.5	N. 31 E.	1.4	36.9	....	21.8	......
April, 1864	6	29.356	29.180	39.2	36.2	.176	.739	0.24	7.2	N. 38 E.	2.7	64.0	....	49.6	......
May, 1864	6	29.250	29.006	49.4	44.9	.244	.686	0.02	7.5	N. 17 E.	1.5	46.1	....	14.0	......
June, 1864	6	29.411	29.023	63.6	56.7	.388	.624	....	3.8	N. 45 E.	0.6	12.8	....	12.1	......
July, 1864	6	29.389	28.888	70.0	63.7	.501	.696	0.07	7.1	S. 46 E.	1.2	......	24.6	25.8	......
August, 1864	6	29.326	28.803	72.4	64.8	.523	.643	0.17	7.3	N. 14 W.	2.5	74.6	....	....	18.4
September, 1864	6	29.358	29.010	57.9	53.0	.348	.705	0.01	7.0	N. 35 E.	2.2	54.4	....	37.8	......
October, 1864	6	29.301	29.060	46.0	42.9	.241	.755	0.11	8.2	N. 56 W.	1.1	18.2	....	....	27.5
November, 1864	6	29.291	29.123	36.3	33.7	.168	.747	0.04	8.4	S. 88 W.	1.9	......	2.5	....	57.6
December, 1864	6	29.250	29.145	24.3	22.3	.105	.717	0.23	9.1	N. 65 W.	2.3	30.4	....	....	65.1
January, 1865	6	29.344	29.267	20.1	17.8	.077	.641	0.07	7.9	N. 53 W.	3.1	58.3	....	....	76.5
February, 1865	6	29.461	29.373	24.0	20.4	.088	.646	0.02	8.7	N. 11 W.	0.9	23.5	....	....	4.5
March, 1865	6	29.283	29.161	30.2	27.3	.122	.677	0.17	8.0	N. 33 W.	4.3	110.6	....	....	71.5
April, 1865	6	29.373	29.208	39.8	35.9	.164	.664	0.04	6.3	N. 44 W.	0.9	18.4	....	....	18.1
May, 1865	6	29.338	29.119	48.9	43.5	.219	.633	0.04	5.9	N. 61 E.	0.7	11.4	....	20.5	......
June, 1865	6	29.337	28.964	60.1	54.9	.373	.721	0.10	6.9	S. 39 E.	2.9	......	66.8	54.4	......
July, 1865	6	29.389	28.971	65.3	59.0	.418	.665	0.06	6.5	N. 14 W.	1.5	45.1	....	....	11.1
August, 1865	6	29.444	28.998	66.5	60.3	.446	.678	0.02	4.2	N. 28 E.	0.7	19.9	....	10.6	......
September, 1865	6	29.423	28.929	66.4	61.7	.494	.755	0.17	6.9	S. 1 E..	2.0	......	60.4	1.6	......
October, 1865	6	29.398	29.147	47.6	44.0	.251	.717	0.08	7.7	N. 16 E	3.2	96.1	....	26.9	......
November, 1865	6	29.428	29.245	40.7	37.2	.183	.698	0.05	7.3	S. 86 W.	1.8	......	3.8	....	49.2
December, 1865	....	......	......	....	....	....	....	....	....	....	....	......	....	....	......
Mean of spring	6	29.309	29.136	39.2	35.4	.172	.679	0.52	6.9	N. 3 E..	1.6	287.4	....	16.3	......
Mean of summer	6	29.383	28.941	66.3	59.9	.441	.671	0.42	6.0	N. 53 E.	0.5	61.0	....	73.4	......
Mean of autumn	6	29.366	29.086	49.1	45.4	.281	.729	0.46	7.6	N. 34 W.	0.7	102.0	....	....	68.0
Mecn of winter	6	29.333	29.235	23.8	21.5	.098	.691	0.63	8.2	N. 50 W.	1.7	198.8	....	....	241.5
Means of all	6	29.348	29.099	44.6	40.5	.248	.692	2.03	7.4	N. 18 W.	0.9	649.2	....	....	219.8

Meteorological observations at Thunder Bay Island, &c.—Continued.

Date.	Time of observation.	Pressure reduced to 32° Fahr.		Temp., Fahr.		Vapor.		Am't of rain and melted snow, U. S. inches and decimals.	Am't cloudiness. (10=sky entirely overcast, 0=clear sky.)	Wind.					
		Total, U. S. inches and decimals.	Gaseous, U. S. inches and decimals.	Dry bulb.	Wet bulb.	Elasticity, U. S. inches and decimals.	Humidity. Saturation=1.000.			Observed direction; from whence.	Observed velocity; miles per hour.	Resolution of direction and velocity, in miles per hour.			
												N.	S.	E.	W.
	P. M.			°	°					°					
December, 1863	5. 30	29. 432	29. 314	27. 8	25. 6	. 118	. 734	....	8. 5	S. 87 E.	1. 6	......	1. 9	47. 1	.....
January, 1864	5. 30	29. 304	29. 204	22. 8	20. 8	. 100	. 703	....	7. 6	N. 66 W.	2. 6	32. 9	....	....	73. 8
February, 1864	5. 30	29. 217	29. 111	25. 0	22. 7	. 106	. 680	....	8. 0	N. 59 W.	3. 8	56. 7	....	...	94. 6
March, 1864	5. 30	29. 247	29. 134	28. 1	25. 4	. 113	. 681	....	6. 8	N. 27 E	1. 9	50. 7	....	27. 6	......
April, 1864	5. 30	29. 358	29. 181	39. 9	36. 7	. 177	. 727	....	7. 8	N. 38 E	2. 6	62. 4	....	48. 2	......
May, 1864	5. 30	29. 250	29. 001	50. 0	45. 5	. 249	. 684	....	7. 6	N. 14 E.	1. 6	49. 1	....	12. 5	......
June, 1864	5. 30	29. 412	29. 017	64. 4	57. 1	. 395	. 631	....	3. 8	S. 78 E.	0. 3	......	1. 7	8. 0	......
July, 1864	5. 30	29. 391	28. 882	70. 8	63. 9	. 509	. 671	....	7. 0	S. 76 E	0. 8	......	6. 0	24. 1	......
August, 1864	5. 30	29. 324	28. 801	73. 1	65. 0	. 523	. 627	....	6. 9	N. 15 W.	2. 2	67. 9	....	....	19. 7
September, 1864	5. 30	29. 354	29. 005	58. 6	53. 3	. 348	. 689	....	7. 2	N. 34 E	2. 5	61. 9	....	41. 0	......
October, 1864	5. 30	29. 300	29. 058	46. 6	43. 2	. 242	. 742	....	8. 2	N. 42 W.	1. 4	32. 9	....	....	29. 5
November, 1864	5. 30	29. 289	29. 122	36. 5	33. 8	. 167	. 740	....	8. 5	N. 86 W.	2. 3	5. 1	....	....	68. 1
December, 1864	5. 30	29. 243	29. 139	24. 4	22. 3	. 104	. 711	....	9. 5	N. 80 W.	2. 2	11. 2	....	....	66. 3
January, 1865	5. 30	29. 339	29. 261	20. 4	18. 0	. 078	. 642	....	8. 1	N. 59 W.	2. 9	47. 1	....	....	77. 3
February, 1865	5. 30	29. 460	29. 371	24. 5	21. 7	. 089	. 636	....	8. 6	N. 7 E..	0. 6	17. 5	....	2. 1	......
March, 1865	5. 30	29. 282	29. 157	30. 9	28. 0	. 125	. 673	....	8. 1	N. 33 W.	4. 1	107. 5	....	....	70. 4
April, 1865	5. 30	29. 371	29. 203	40. 3	36. 5	. 168	. 663	....	6. 3	S. 82 W.	0. 2	......	0. 8	....	6. 1
May, 1865	5. 30	29. 337	29. 113	49. 7	44. 1	. 224	. 627	....	6. 0	N. 53 E.	1. 3	23. 7	...	31. 1	......
June, 1865	5. 30	29. 339	28. 961	60. 4	55. 4	. 378	. 715	....	6. 7	S. 29 E.	2. 4	......	62. 7	35. 2	......
July, 1865	5. 30	29. 394	28. 975	65. 9	59. 2	. 419	. 653	....	6. 3	N. 17 W.	1. 6	47. 7	....	....	14. 3
August, 1865	5. 30	29. 444	28. 995	67. 5	60. 8	. 449	. 639	....	4. 2	N. 47 E.	0. 5	10. 9	....	11. 5	......
September, 1865	5. 30	29. 423	28. 926	67. 0	62. 0	. 497	. 742	....	6. 9	S. 11 E.	1. 9	......	56. 7	10. 9	......
October, 1865	5. 30	29. 395	29. 138	48. 3	44. 6	. 257	. 716	....	7. 8	N. 10 E.	3. 2	96. 1	....	16. 4	......
November, 1865	5. 30	29. 422	29. 241	41. 0	37. 5	. 181	. 694	....	7. 0	N. 89 W.	1. 6	0. 8	....	....	44. 1
December, 1865	....	....	....	....	....	....	....	....	....	....	....	......	....	....	......
Mean of spring	5. 30	29. 307	29. 131	39. 8	36. 0	. 176	. 676	....	7. 1	N. 7 E..	1. 6	292. 6	....	42. 9	......
Mean of summer	5. 30	29. 384	28. 938	67. 0	60. 2	. 445	. 659	....	5. 8	N. 31 E.	0. 4	56. 1	....	44. 8	......
Mean of autumn	5. 30	29. 364	29. 082	49. 7	45. 7	. 282	. 721	....	7. 6	N. 26 W.	0. 9	140. 1	....	....	73. 4
Mean of winter	5. 30	29. 332	29. 233	24. 1	21. 8	. 099	. 684	....	8. 4	N. 59 W.	1. 7	163. 5	....	....	262. 8
Means of all	5. 30	29. 347	29. 096	45. 1	40. 9	. 250	. 685	....	7. 2	N. 18 W.	0. 9	652. 3	....	....	248. 5
December, 1863	5	29. 431	29. 311	27. 9	25. 7	. 120	. 737	0. 12	8. 6	S. 70 E.	2. 5	......	26. 4	72. 4	......
January, 1864	5	29. 303	29. 202	23. 1	21. 1	. 101	. 709	0. 06	7. 6	N. 61 W.	2. 4	35. 7	....	....	63. 8
February, 1864	5	29. 216	29. 110	25. 4	23. 0	. 106	. 674	0. 11	8. 3	N. 55 W.	3. 9	65. 1	....	....	92. 5
March, 1864	5	29. 247	29. 133	28. 6	25. 9	. 114	. 677	0. 05	6. 9	N. 33 E.	2. 1	55. 3	....	36. 4	......
April, 1864	5	29. 359	29. 181	40. 3	37. 0	. 177	. 720	0. 19	7. 9	N. 41 E	2. 9	64. 5	....	56. 3	......
May, 1864	5	29. 251	29. 003	50. 9	45. 8	. 248	. 661	....	7. 2	N. 18 E	1. 4	40. 4	....	13. 3	.....
June, 1864	5	29. 412	29. 014	65. 0	57. 6	. 398	. 611	....	4. 2	S. 73 E.	0. 5	......	4. 3	14. 6	......
July, 1864	5	29. 393	28. 869	71. 6	64. 6	. 523	. 673	0. 04	6. 8	S. 73 E.	0. 7	......	6. 6	20. 6	......
August, 1864	5	29. 323	28. 802	73. 9	65. 3	. 521	. 611	0. 02	6. 9	N. 10 W.	2. 3	70. 2	....	....	12. 0
September, 1864	5	29. 351	28. 999	59. 3	53. 8	. 352	. 679	....	7. 1	N. 39 E.	2. 4	55. 0	....	44. 1	......
October, 1864	5	29. 300	29. 057	47. 1	43. 6	. 243	. 734	0. 21	8. 0	N. 54 W	1. 1	19. 0	....	....	26. 7
November, 1864	5	29. 291	29. 124	36. 6	33. 9	. 167	. 737	0. 10	8. 1	N. 76 W.	2. 6	18. 9	....	....	72. 0
December, 1864	5	29. 237	29. 132	24. 5	22. 5	. 105	. 709	0. 18	9. 4	N. 82 W.	2. 5	11. 0	....	....	76. 6
January, 1865	5	29. 333	29. 254	20. 7	18. 3	. 079	. 641	0. 04	8. 3	N. 59 W.	2. 8	44. 9	....	....	72. 9
February, 1865	5	29. 454	29. 364	24. 9	22. 1	. 090	. 642	0. 10	8. 5	N. 12 E.	0. 7	20. 0	....	4. 5	......
March, 1865	5	29. 283	29. 156	31. 6	28. 5	. 127	. 656	0. 18	8. 4	N. 35 W.	4. 3	108. 3	....	....	77. 3
April, 1865	5	29. 368	29. 199	41. 0	36. 9	. 169	. 652	0. 02	6. 2	N. 8 W.	0. 2	0. 9	....	....	5. 2
May, 1865	5	29. 335	29. 110	50. 3	44. 5	. 225	. 618	0. 05	6. 0	N. 56 E.	1. 3	22. 3	....	32. 3	......
June, 1865	5	29. 341	28. 961	61. 1	55. 8	. 381	. 703	0. 15	6. 4	S. 23 E.	2. 2	......	59. 8	25. 6	......
July, 1865	5	29. 390	28. 966	66. 5	59. 7	. 425	. 649	0. 05	6. 2	N. 22 W.	1. 4	40. 0	....	....	16. 6
August, 1865	5	29. 447	28. 994	68. 4	61. 3	. 452	. 644	0. 33	4. 3	N. 30 E.	0. 6	15. 1	....	9. 1	......
September, 1865	5	29. 421	28. 919	67. 8	62. 5	. 502	. 732	0. 20	6. 9	S. 2 W.	2. 6	......	79. 4	....	2. 5
October, 1865	5	29. 392	29. 128	49. 2	45. 3	. 264	. 710	0. 04	7. 4	N. 9 E..	3. 1	94. 6	....	14. 7	......
November, 1865	5	29. 414	29. 229	41. 4	37. 7	. 185	. 687	....	7. 5	N. 89 W.	1. 5	1. 0	....	....	43. 2
December, 1865	....	....	....	....	....	....	....	....	....	....	....	......	....	....	......
Mean of spring	5	29. 307	29. 130	40. 4	36. 4	. 177	. 664	0. 49	7. 1	N. 11 E.	1. 6	291. 7	....	55. 8	......
Mean of summer	5	29. 384	28. 934	67. 7	60. 7	. 450	. 648	0. 59	5. 8	N. 34 E.	0. 4	54. 6	....	41. 3	......
Mean of autumn	5	29. 361	29. 076	50. 2	46. 1	. 285	. 713	0. 55	7. 5	N. 40 W.	0. 8	109. 1	....	....	85. 6
Mean of winter	5	29. 329	29. 229	24. 4	22. 1	. 100	. 685	0. 61	8. 4	N. 58 W.	1. 5	150. 3	....	....	229. 0
Means of all	5	29. 345	29. 092	45. 7	41. 3	. 253	. 677	2. 24	7. 2	N. 21 W.	0. 8	605. 7	....	....	217. 5

Meteorological observations at Thunder Bay Island, &c.—**Continued.**

Date.	Time of observation.	Pressure reduced to 32° Fahr.		Temp., Fahr.		Vapor.		Am't of rain and melted snow, U. S. inches and decimals.	Am't cloudiness. (10=sky entirely overcast, 0=clear sky.)	Wind.					
		Total, U. S. inches and decimals.	Gaseous, U. S. inches and decimals.	Dry bulb.	Wet bulb.	Elasticity, U. S. inches and decimals.	Humidity, Saturation=1.000			Observed direction; from whence.	Observed velocity; miles per hour.	Resolution of directio and velocity, in miles per hour.			
												N.	S.	E.	W.
	P.M.			°	°					°					
December, 1863	4.30	29.431	29.313	28.1	25.9	.118	.738	...	8.5	S. 72 E.	2.6	......	25.7	76.3	......
January, 1864	4.30	29.304	29.203	23.6	21.3	.102	.702	....	7.3	N. 60 W.	2.5	38.5	....	....	67.1
February, 1864	4.30	29.210	29.103	25.8	23.4	.107	.671	....	8.5	N. 60 W.	3.3	71.8	....	....	82.2
March, 1864	4.30	29.243	29.126	29.3	26.5	.117	.678	....	7.0	N. 26 E.	2.3	53.2	....	42.9	......
April, 1864	4.30	29.360	29.182	40.7	37.2	.179	.712	....	7.9	N. 37 E.	3.3	78.7	....	58.4	......
May, 1864	4.30	29.251	29.001	51.2	46.1	.250	.658	....	7.3	N. 5 E.	1.9	57.9	....	5.1	......
June, 1864	4.30	29.416	29.012	65.3	57.8	.404	.622	....	4.2	S. 70 E.	0.6	......	6.1	17.7	......
July, 1864	4.30	29.393	28.865	72.4	65.1	.527	.662	....	6.9	N. 53 E.	0.9	16.2	....	21.6	......
August, 1864	4.30	29.323	28.804	74.5	65.5	.519	.595	....	6.7	N. 4 W.	2.4	74.2	....	....	7.7
September, 1864	4.30	29.346	28.992	60.0	54.2	.354	.669	....	7.2	N. 41 E.	2.0	44.7	....	38.1	......
October, 1864	4.30	29.293	29.047	47.6	44.0	.246	.728	....	8.1	N. 40 W.	0.6	13.9	....	....	11.0
November, 1864	4.30	29.288	29.120	37.0	34.2	.168	.729	....	8.3	N. 86 W.	2.4	5.1	....	....	69.0
December, 1864	4.30	29.230	29.125	24.7	22.6	.105	.707	....	9.4	S. 83 W.	2.5	......	9.5	....	77.7
January, 1865	4.30	29.328	29.249	21.0	18.6	.079	.635	....	8.7	N. 62 W.	2.8	40.8	....	....	76.6
February, 1865	4.30	29.450	29.357	25.6	22.8	.093	.639	....	8.5	N. 14 E.	1.0	26.2	....	6.2	......
March, 1865	4.30	29.280	29.148	32.3	29.1	.132	.658	....	8.4	N. 38 W.	4.2	103.5	....	....	81.1
April, 1865	4.30	29.366	29.198	41.5	37.1	.168	.636	....	6.2	S. 34 W.	0.2	......	5.1	....	3.4
May, 1865	4.30	29.333	29.106	51.0	45.0	.227	.606	....	5.5	N. 61 E.	1.2	18.5	....	32.2	......
June, 1865	4.30	29.344	28.956	61.5	56.2	.388	.702	....	6.4	S. 27 E.	1.4	......	37.4	19.4	......
July, 1865	4.30	29.389	28.965	67.1	59.9	.424	.637	....	6.4	N. 57 W.	1.5	45.5	....	....	14.2
August, 1865	4.30	29.443	28.986	69.4	61.8	.457	.629	....	4.5	N. 26 E.	0.7	19.7	....	9.8	......
September, 1865	4.30	29.422	28.916	68.5	62.9	.506	.720	....	6.9	South	2.4	......	71.9	....	0.3
October, 1865	4.30	29.388	29.118	49.9	45.9	.270	.704	....	7.5	N. 8 E.	3.2	98.4	....	13.6	......
November, 1865	4.30	29.411	29.225	42.0	38.1	.187	.679	....	7.2	S. 86 W.	1.5	......	2.6	....	42.1
December, 1865	....	......	......	....	....	....	....	....	....	....	....	......	....	....	......
Mean of spring	4.30	29.305	29.127	41.0	36.8	.179	.658	....	7.0	N. 10 E.	1.7	311.7	....	55.1	......
Mean of summer	4.30	29.385	28.931	68.4	61.0	.453	.641	....	5.8	N. 26 E.	0.7	112.1	....	46.6	......
Mean of autumn	4.30	29.358	29.070	50.8	46.5	.288	.705	....	7.5	N. 38 W.	0.6	87.6	....	....	70.7
Mean of winter	4.30	29.325	29.225	24.8	22.4	.104	.682	....	8.5	N. 60 W.	1.4	118.1	....	....	221.1
Means of all	4.30	29.343	29.088	46.2	41.7	.256	.671	....	7.2	N. 18 W.	0.9	629.5	....	....	190.1
December, 1863	4	29.431	29.312	28.3	26.0	.119	.727	0.10	8.9	S. 74 E.	2.3	......	19.1	69.0	......
January, 1864	4	29.302	29.200	23.6	21.5	.102	.703	0.07	7.7	N. 66 W.	2.5	32.0	....	....	70.0
February, 1864	4	29.204	29.096	26.4	23.8	.108	.669	0.05	8.4	N. 65 W.	3.4	41.7	....	....	89.6
March, 1864	4	29.240	29.124	29.7	26.7	.116	.665	0.21	7.2	N. 37 E.	3.1	75.7	...	57.6	......
April, 1864	4	29.359	29.182	40.9	37.3	.178	.703	0.24	8.2	N. 37 E.	3.6	87.3	....	65.8	......
May, 1864	4	29.251	29.002	51.7	46.3	.249	.644	0.03	7.5	N. 12 E.	2.1	63.8	....	13.5	......
June, 1864	4	29.419	29.019	65.5	57.7	.400	.610	....	4.3	S. 80 E.	0.7	......	3.5	19.9	......
July, 1864	4	29.394	28.866	72.8	65.3	.528	.655	0.23	6.9	N. 45 E.	1.0	22.2	....	22.2	......
August, 1864	4	29.322	28.799	75.1	65.8	.523	.589	0.04	6.6	N. 2 W.	2.4	73.3	....	....	4.4
September, 1864	4	29.345	28.986	60.4	54.6	.359	.667	....	7.1	N. 36 E.	2.3	55.4	....	40.0	......
October, 1864	4	29.291	29.043	48.2	44.4	248	.720	0.22	8.2	N. 26 W.	0.9	24.3	....	....	11.9
November, 1864	4	29.286	29.118	37.5	34.5	.168	.719	0.09	8.4	N. 86 W.	2.3	4.6	....	....	68.9
December, 1864	4	29.224	29.119	24.9	22.8	.105	.705	0.25	9.4	N. 72 W.	2.9	28.0	....	....	86.8
January, 1865	4	29.324	29.244	21.5	19.0	.08[illegible]	.625	0.03	8.4	N. 64 W.	3.0	41.0	....	....	82.9
February, 1865	4	29.447	29.351	26.4	23.4	096	.639	0.02	8.5	N. 7 E.	1.0	27.3	....	3.4	......
March, 1865	4	29.277	29.145	32.9	29.6	.131	.653	0.24	8.5	N. 42 W.	3.5	81.2	....	....	72.6
April, 1865	4	29.363	29.197	42.1	37.4	.167	.620	0.05	6.3	S. 69 W.	1.7	......	4.7	....	18.1
May, 1865	4	29.334	29.105	51.3	45.2	.229	.604	0.04	5.5	N. 59 E	1.1	18.0	....	30.2	......
June, 1865	4	29.353	28.967	61.9	56.3	.386	691	0.31	6.3	S. 9 E.	2.2	......	65.6	10.2	......
July, 1865	4	29.390	28.962	67.8	60.3	.429	.629	....	6.4	N. 13 W.	1.7	50.7	....	....	11.7
August, 1865	4	29.444	28.982	70.0	62.2	.462	.617	0.33	4.6	N. 17 E.	0.7	21.7	....	6.8	......
September, 1865	4	29.421	28.905	69.1	63.4	.516	.719	0.47	6.8	S. 9 E.	2.7	......	82.6	13.2	......
October, 1865	4	29.386	29.109	50.6	46.5	.277	.703	0.12	7.7	N. 4 E.	3.1	94.1	....	6.2	......
November, 1865	4	29.408	29.221	42.1	38.4	.187	.667	0.04	6.8	N. 88 W.	1.2	1.3	....	....	35.1
December, 1865	....	......	......	....	....	....	....	....	....	....	....	......	....	....	......
Mean of spring	4	29.304	29.126	41.4	37.1	.178	.645	0.81	7.2	N. 13 E.	1.8	321.3	....	76.4	......
Mean of summer	4	29.387	28.932	68.8	61.3	.455	.632	0.91	5.8	N. 22 E.	0.5	98.8	....	43.0	......
Mean of autumn	4	29.356	29.064	51.3	47.0	.292	699	0.94	7.5	N. 31 W.	0.6	97.1	....	....	56.5
Mean of winter	4	29.322	29.220	25.2	22.7	.102	.678	0.52	8.5	N. 60 W.	1.6	150.9	....	....	256.9
Means of all	4	29.342	29.085	46.7	42.0	.257	.663	3.18	7.2	N. 18 W.	0.9	668.1	....	....	194.0

Meteorological observations at Thunder Bay Island, &c.—Continued.

Date.	Time of observation.	Pressure reduced to 32° Fahr.		Temp., Fahr.		Vapor.		Am't of rain and melted snow, U. S. inches and decimals.	Am't cloudiness. (10=sky entirely overcast, 0=clear sky.)	Wind.					
		Total, U. S. inches and decimals.	Gaseous, U. S. inches and decimals.	Dry bulb.	Wet bulb.	Elasticity, U. S. inches and decimals.	Humidity. Saturation=1.000.			Observed direction; from whence.	Observed velocity; miles per hour.	Resolution of direction and velocity, in miles per hour.			
												N.	S.	E.	W.
	P. M.			°	°					°					
December, 1863	3.30	29.430	29.311	28.6	26.2	.119	.724	....	8.8	S. 81 E	2.2	......	10.6	69.3	......
January, 1864	3.30	29.296	29.194	24.3	22.0	.102	.692	....	7.7	N. 68 W.	2.7	32.7	....	....	78.2
February, 1864	3.30	29.199	29.091	26.7	24.0	.108	.659	....	8.7	N. 61 W.	3.2	45.5	....	....	82.1
March, 1864	3.30	29.238	29.123	30.0	26.9	.115	.654	....	7.2	N. 34 E.	3.3	85.3	....	58.8	......
April, 1864	3.30	29.365	29.188	41.0	37.4	.177	.699	....	7.9	N. 45 E.	4.0	86.0	....	85.3	......
May, 1864	3.30	29.251	28.998	51.9	46.6	.253	.651	....	7.5	N. 1 E.	1.8	57.2	....	1.2	......
June, 1864	3.30	29.423	29.019	66.1	58.2	.404	.595	....	4.7	S. 77 E	0.9	......	6.0	26.8	......
July, 1864	3.30	29.398	28.868	73.0	65.4	.530	.657	....	7.0	N. 22 E	1.2	35.2	....	14.2	......
August, 1864	3.30	29.324	28.799	75.4	66.0	.525	.583	....	6.6	N. 18 W.	2.5	74.7	....	....	24.4
September, 1864	3.30	29.347	28.993	60.7	54.6	.354	.655	....	7.0	N. 25 E	2.4	63.9	....	30.2	......
October, 1864	3.30	29.287	29.036	48.7	44.8	.251	.718	....	8.2	N. 19 W.	0.3	9.8	....	....	3.3
November, 1864	3.30	29.284	29.115	37.8	34.8	.169	.707	...	8.4	S. 84 W.	2.5	......	7.0	....	76.0
December, 1864	3.30	29.219	29.113	25.2	23.0	.106	.701	.09	9.5	N. 81 W.	3.7	18.2	....	....	112.9
January, 1865	3.30	29.322	29.241	22.0	19.4	.081	.624	....	8.5	N. 67 W.	3.2	38.1	....	....	90.5
February, 1865	3.30	29.446	29.348	27.2	24.1	.098	.624	....	8.2	N. 12 E.	1.0	26.1	....	5.2	......
March, 1865	3.30	29.275	29.141	33.5	30.1	.134	.652	....	8.3	N. 36 W.	3.3	83.8	....	....	60.3
April, 1865	3.30	29.361	29.194	42.5	37.7	.167	.611	....	6.7	S. 41 W.	1.1	......	24.6	....	21.5
May, 1865	3.30	29.336	29.106	51.4	45.2	.230	.597	....	5.4	N. 56 E.	1.1	19.4	....	29.0	......
June, 1865	3.30	29.351	28.963	62.2	56.5	.388	.687	....	6.5	S. 11 E.	2.3	......	67.5	13.3	......
July, 1865	3.30	29.391	28.961	68.0	60.5	.431	.627	....	6.4	N. 20 W.	1.4	42.5	....	....	14.9
August, 1865	3.30	29.446	28.982	70.6	62.5	.464	.614	....	4.9	S. 88 E.	0.2	......	0.2	7.1	......
September, 1865	3.30	29.421	28.902	69.8	63.8	.519	.707	....	6.6	S. 14 E.	2.7	......	80.4	20.8	......
October, 1865	3.30	29.382	29.102	51.1	46.9	.281	.700	....	7.8	N. 5 W.	3.1	95.3	....	....	7.8
November, 1865	3.30	29.407	29.218	42.9	38.6	.188	.649	....	6.8	N. 83 W.	1.4	5.3	....	....	41.3
December, 1865	3.30	......	......	....	....	....	....	....	....	....	....	......	....	....	......
Mean of spring	3.30	29.304	29.125	41.7	37.3	.179	.644	....	7.2	N. 17 E.	1.8	307.1	....	92.5	......
Mean of summer	3.30	29.389	28.932	69.2	61.5	.457	.627	....	6.0	N. 14 E.	0.4	78.7	....	22.1	......
Mean of autumn	3.30	29.355	29.061	51.8	47.2	.294	.689	....	7.5	N. 42 W.	0.6	86.9	....	....	77.4
Mean of winter	3.30	29.319	29.216	25.7	23.1	.102	.671	...	8.6	N. 63 W.	1.8	150.0	....	....	289.2
Means of all	3.30	29.342	29.083	47.1	42.3	.258	.658	....	7.3	N. 18 W.	0.9	622.7	....	...	252.0
December, 1863	3	29.428	29.308	28.8	26.4	.120	.715	0.12	8.8	S. 80 E.	2.6	......	13.6	78.0	......
January, 1864	3	29.292	29.188	24.8	22.4	.104	.685	0.06	7.5	N. 71 W.	3.0	29.9	...	....	88.5
February, 1864	3	29.199	29.088	27.0	24.3	.111	.667	0.05	9.0	N. 63 W.	3.7	49.1	....	....	97.6
March, 1864	3	29.238	29.122	30.1	26.9	.116	.653	0.17	7.0	N. 32 E.	3.5	89.9	....	56.4	......
April, 1864	3	29.362	29.183	41.1	37.5	.178	.701	0.21	7.7	N. 40 E.	4.0	92.0	....	78.7	......
May, 1864	3	29.255	29.004	51.6	46.3	.251	.654	....	7.1	N. 15 E.	2.0	59.0	....	15.7	......
June, 1864	3	29.427	29.026	66.4	58.2	.401	.589	....	4.6	S. 73 E.	1.3	......	11.6	37.1	......
July, 1864	3	29.402	28.872	73.2	65.5	.530	.655	0.34	6.8	N. 55 E.	1.4	26.6	....	35.0	......
August, 1864	3	29.327	28.795	75.8	66.2	.532	.582	....	6.7	N. 21 W.	2.6	75.1	....	....	26.8
September, 1864	3	29.348	28.992	61.1	54.8	.355	.646	0.07	7.4	N. 29 E	2.9	76.6	....	41.0	......
October, 1864	3	29.285	29.035	49.1	45.0	.250	.709	0.14	8.2	N. 25 E.	0.3	9.1	....	4.2	......
November, 1864	3	29.282	29.112	38.3	35.1	.170	.697	0.12	8.5	S. 83 W.	2.5	......	8.6	....	75.7
December, 1864	3	29.216	29.110	25.3	23.1	.106	.699	0.27	9.4	N. 82 W.	3.6	16.5	....	....	110.6
January, 1865	3	29.322	29.240	22.4	19.7	.082	.615	0.04	8.5	N. 68 W.	3.2	38.0	....	....	94.2
February, 1865	3	29.442	29.344	27.7	24.4	.098	.611	0.07	8.1	N. 21 E.	1.5	39.4	....	15.6	......
March, 1865	3	29.274	29.137	33.9	30.5	.137	.654	0.09	8.2	N. 37 W.	2.8	70.6	....	....	52.8
April, 1865	3	29.362	29.192	42.9	38.0	.170	.610	....	7.1	S. 59 W.	1.3	......	20.1	....	33.6
May, 1865	3	29.338	29.110	51.5	45.3	.228	.595	0.10	5.5	N. 73 E.	1.1	10.1	....	33.1	......
June, 1865	3	29.351	28.958	62.5	56.8	.393	.687	0.35	6.9	S. 10 E	2.7	......	79.9	14.0	......
July, 1865	3	29.392	28.964	68.1	60.5	.428	.621	....	6.3	N. 38 W.	1.2	30.4	....	....	23.3
August, 1865	3	29.449	28.982	71.0	63.1	.467	.608	0.40	4.7	N. 26 E.	0.4	11.3	....	5.2	......
September, 1865	3	29.422	28.900	70.3	64.1	.522	.700	0.27	6.6	S. 13 E.	2.6	......	78.9	17.4	......
October, 1865	3	29.381	29.099	51.3	47.0	.281	.693	0.13	7.3	N. 15 E	3.3	99.8	....	26.3	......
November, 1865	3	29.405	29.218	43.3	38.9	.187	.639	....	7.0	N. 87 W.	1.6	2.6	....	....	47.1
December, 1865	....	......	....	....	...	....	....	....	....	....	....	......	....	....	......
Mean of spring	3	29.305	29.125	41.8	37.4	.179	.644	0.57	7.1	N. 17 E.	1.7	301.5	....	97.5	......
Mean of summer	3	29.391	28.933	69.5	61.7	.458	.624	1.09	6.0	N. 34 E.	0.4	51.9	....	41.2	......
Mean of autumn	3	29.354	29.059	5.22	47.5	.292	.681	0.73	7.5	N. 22 W.	0.5	100.6	....	....	33.9
Mean of winter	3	29.316	29.213	26.0	23.4	.103	.665	0.61	8.5	N. 61 W.	1.8	159.3	....	....	297.3
Means of all	3	29.341	29.082	47.4	42.5	.258	.653	3.00	7.3	N. 20 W.	0.9	613.3	....	....	192.5

Meteorological observations at Thunder Bay Island, &c.—Continued.

Date.	Time of observation.	Pressure reduced to 32° Fahr.		Temp., Fahr.		Vapor.		Am't of rain and melted snow, U. S. inches and decimals.	Am't cloudiness, (10=sky entirely overcast. 0=clear sky.)	Wind.					
		Total U. S. inches and decimals.	Gaseous, U. S. inches and decimals.	Dry bulb.	Wet bulb.	Elasticity, U. S. inches and decimals.	Humidity. Saturation = 1.000.			Observed direction; from whence.	Observed velocity; miles per hour.	Resolution of direction and velocity, in miles per hour.			
												N.	S.	E.	W.
	P. M.			°	°					°					
December, 1863	2. 30	29. 433	29. 311	29. 1	26. 6	. 122	. 728	....	8. 9	S. 81 E.	2. 2	......	10. 8	68. 2	....
January, 1864	2. 30	29. 287	29. 183	25. 1	22. 7	. 104	. 680	....	7. 5	N. 65 W.	2. 7	36. 5	....	....	77.0
February, 1864	2. 30	29. 199	29. 088	27. 1	24. 4	. 111	. 668	....	9. 0	N. 66 W.	3. 1	39. 4	....	....	88.7
March, 1864	2. 30	29. 238	29. 120	30. 4	27. 3	. 118	. 656	....	7. 0	N. 37 E.	3 3	81. 4	...	61. 0	....
April, 1864	2. 30	29. 366	29. 186	41. 0	37. 5	. 179	. 704	....	7. 7	N. 44 E.	3. 9	84. 5	....	82. 1	....
May, 1864	2. 30	29. 260	29. 009	51. 1	46. 1	. 251	. 667	....	7. 3	N. 17 E	1. 9	57. 0	....	17. 3	....
June, 1864	2. 30	29. 429	29. 032	66. 4	58. 1	. 397	. 587	....	4. 6	S. 70 E.	0. 8	......	8. 9	23. 7	....
July, 1864	2. 30	29. 405	28. 873	73. 2	65. 5	. 532	. 650	....	6. 8	S. 83 E.	2. 2	......	8. 3	67. 3	....
August, 1864	2. 30	29. 328	28. 792	76. 3	66. 6	. 536	. 578	....	6. 6	N. 11 W.	2. 1	65. 3	....	....	13.1
September, 1864	2. 30	29. 353	28. 993	61. 3	55. 0	. 360	. 655	....	7. 6	N. 27 E.	3. 0	80. 4	....	40. 5	....
October, 1864	2. 30	29. 287	29. 032	49. 6	45. 4	. 255	. 707	....	8. 1	N. 16 E.	0. 5	14. 3	....	0. 4	....
November, 1864	2. 30	29. 280	29. 111	38. 5	35. 2	. 169	. 687	....	8. 7	S. 83 W.	3. 3	......	11. 6	....	97.2
December, 1864	2. 30	29. 213	29. 108	25. 5	23. 2	. 105	. 685	....	9. 5	N. 83 W.	2. 6	10. 1	....	....	80.6
January, 1865	2. 30	29. 321	29. 239	22. 5	19. 8	. 082	. 622	....	8. 5	N. 65 W.	3. 6	48. 4	....	....	102.6
February, 1865	2. 30	29. 446	29. 347	27. 9	25. 3	. 099	. 610	....	8. 0	N. 9 E.	1. 4	37. 4	....	6. 1	....
March, 1865	2. 30	29. 276	29. 137	34. 1	30. 7	. 139	. 656	....	8. 0	N. 46 W.	2. 7	58. 3	...	....	59.8
April, 1865	2. 30	29. 361	29. 190	43. 2	38. 3	. 171	. 609	....	7. 0	S. 56 W.	1. 5	......	25. 0	....	37.2
May, 1865	2. 30	29. 339	29. 111	51. 2	45. 2	. 228	. 601	....	5. 3	N. 86 E.	1. 8	3. 7	....	56. 8	....
June, 1865	2. 30	29. 354	28. 959	62. 7	56. 9	. 395	. 682	....	7. 0	S. 9 E.	2. 7	......	81. 9	12. 2	....
July, 1865	2. 30	29. 396	28. 969	68. 1	60. 5	. 427	. 620	....	6. 1	N. 37 W.	1. 0	24. 2	....	....	18.1
August, 1865	2. 30	29. 453	28. 985	71. 3	62. 9	. 468	. 603	....	4. 8	N. 31 E.	0. 4	11. 4	....	6. 8	....
September, 1865	2. 30	29. 421	28. 894	70. 4	64. 2	. 527	. 702	....	6. 4	S. 5 E.	3. 1	......	94. 7	8. 4	....
October, 1865	2. 30	29. 381	29. 099	51. 4	47. 1	. 282	. 692	....	7. 3	N. 16 E.	3. 4	100. 6	....	28. 9	....
November, 1865	2. 30	29. 404	29. 218	43. 4	38. 9	. 186	. 637	....	7. 1	S. 77 W.	1. 7	......	10. 4	....	46.3
December, 1865	....	......	......	....	....	....	....	....	....	....	....	......	....	....	....
Mean of spring	2. 30	29. 307	29. 125	41. 8	37. 5	. 181	. 649	....	7. 1	N. 26 E.	1. 6	259. 9	....	120. 2	....
Mean of summer	2. 30	29. 394	28. 935	69. 7	61. 7	. 459	. 620	....	5. 8	East....	0. 4	1. 8	....	78. 8	....
Mean of autumn	2. 30	29. 354	29. 058	52. 4	47. 6	. 296	. 680	....	7. 5	N. 45 W.	0. 6	78. 6	....	....	65.3
Mean of winter	2. 30	29. 316	29. 213	26. 2	23. 7	. 104	. 665	....	8. 6	N. 59 W.	1. 8	161. 0	....	....	274.8
Means of all	2. 30	29. 343	29. 083	47. 5	42. 6	. 260	. 653	....	7. 2	N. 16 W.	0. 7	501. 3	....	....	141.1
December, 1863	2	29. 427	29. 304	29. 2	26. 8	. 123	. 734	0. 06	9. 1	S. 78 E.	2. 3	......	15. 7	72. 6	....
January, 1864	2	29. 281	29. 177	25. 5	22. 8	. 104	. 659	0. 09	7. 4	N. 78 W.	3. 3	20. 6	....	....	100.3
February, 1864	2	29. 189	29. 077	27. 3	24. 6	. 112	. 668	0. 04	8. 7	N. 65 W.	3. 1	36. 8	....	....	80.1
March, 1864	2	29. 242	29. 124	30 8	27. 5	. 119	. 649	0. 18	7. 0	N. 30 E.	3. 0	72. 9	....	59. 6	....
April, 1864	2	29. 367	29. 188	40. 8	37. 4	. 179	. 704	0. 13	7. 5	N. 41 E.	4. 3	98. 4	....	84. 0	....
May, 1864	2	29. 263	29. 013	51. 2	46. 1	. 250	. 660	0. 09	7. 2	N. 19 E.	2. 0	57. 3	....	19. 6	....
June, 1864	2	29. 436	29. 042	66. 5	58. 4	. 394	. 580	0. 10	4. 6	S. 84 E	1. 0	......	3. 3	30. 1	....
July, 1864	2	29. 409	28. 879	73. 1	65. 4	. 530	. 647	0. 13	6. 5	S. 81 E.	2. 5	......	12. 0	75. 9	....
August, 1864	2	29. 331	28. 792	76. 5	66. 7	. 539	. 579	....	6. 1	N. 11 W.	2. 6	77. 4	....	....	16.1
September, 1864	2	29. 351	28. 991	61. 5	55. 2	. 360	. 646	0. 09	7. 6	N. 22 E.	2. 8	76. 8	....	31. 1	....
October, 1864	2	29. 288	29. 031	49. 7	45. 5	. 257	. 708	0. 15	7. 9	N. 62 E.	0. 6	8. 8	....	15. 2	....
November, 1864	2	29. 283	29. 116	38. 4	35. 0	. 167	. 683	0. 12	8. 5	N. 86 W.	2. 7	5. 1	....	....	81.0
December, 1864	2	29. 213	29. 108	25. 4	23. 1	. 105	. 680	0. 29	9. 3	S. 87 W.	3. 1	......	5. 6	....	95.6
January, 1865	2	29. 323	29. 241	22. 4	19. 7	. 081	. 613	0. 06	8. 6	N. 65 W.	3. 4	45. 0	....	....	93.4
February, 1865	2	29. 449	29. 349	27. 7	24. 5	. 099	. 616	0. 02	8. 2	N. 2 E.	1. 8	50. 6	....	1. 5	....
March, 1865	2	29. 285	29. 144	34. 3	30. 9	. 141	. 658	0. 10	7. 6	N. 52 W.	2. 6	51. 1	....	....	64.5
April, 1865	2	29. 361	29. 189	43. 3	38. 4	. 172	. 612	0. 04	7. 7	S. 76 W.	2. 0	......	14. 2	....	57.2
May, 1865	2	29. 343	29. 115	51. 2	45. 2	. 228	. 603	0. 05	5. 2	N. 85 E.	1. 6	4. 4	....	51. 1	....
June, 1865	2	29. 358	28. 959	62. 7	57. 1	. 399	. 689	0. 09	6. 9	S. 19 E.	3. 2	......	91. 0	31. 7	....
July, 1865	2	29. 399	28. 970	67. 9	60. 5	. 429	. 629	....	6. 1	N. 30 W.	1. 1	28. 0	....	....	16.5
August, 1865	2	29. 456	28. 981	71. 2	63. 0	. 475	. 613	0. 12	4. 8	N. 37 E.	0. 5	12. 5	....	9. 0	....
September, 1865	2	29. 427	28. 903	70. 2	64. 1	. 524	. 702	0. 35	6. 3	S. 1 W.	2. 8	......	84. 2	....	1.9
October, 1865	2	29. 383	29. 104	51. 4	47. 0	. 279	. 684	0. 03	7. 3	N. 11 E.	3. 2	97. 2	....	18. 1	....
November, 1865	2	29. 406	29. 219	43. 2	38. 8	. 187	. 642	....	7. 2	S. 77 W.	1. 8	......	12. 1	....	51.8
December, 1865	....	......	......	....	....	....	....	....	....	....	....	......	....	....	....
Mean of spring	2	29. 310	29. 129	41. 9	37. 6	. 181	. 648	0. 59	7. 0	N. 18 E.	1. 6	269. 9	....	92. 6	....
Mean of summer	2	29. 398	28. 937	69. 6	61. 8	. 461	. 623	0. 44	5. 8	N. 80 E.	0. 6	11. 6	....	114. 1	....
Mean of autumn	2	29. 356	29. 061	52. 6	47. 6	. 296	. 677	0. 74	7. 5	N. 45 W.	0. 7	91. 6	....	....	90.3
Mean of winter	2	29. 314	29. 209	26. 2	23. 6	. 104	. 662	0. 56	8. 5	N. 66 W.	1. 7	131. 7	....	....	297.3
Means of all	2	29. 344	29. 084	47. 6	42. 6	. 260	. 654	2. 33	7. 2	N. 16 W.	0. 7	504. 8	....	....	180.9

Meteorological observations at Thunder Bay Island, &c.—Continued.

Date.	Time of observation.	Pressure reduced to 32° Fahr.		Temp., Fahr.		Vapor.		Am't of rain and melted snow, U. S. inches and decimals.	Am't cloudiness. (10=sky entirely overcast, 0=clear sky.)	Wind.					
		Total, U. S. inches and decimals.	Gaseous, U. S. inches and decimals.	Dry bulb.	Wet bulb.	Elasticity, U. S. inches and decimals.	Humidity. Saturation=1.000.			Observed direction; from whence.	Observed velocity; miles per hour.	Resolution of direction and velocity, in miles per hour.			
												N.	S.	E.	W.
	P.M.			°	°					°					
December, 1863	1.30	29.428	29.304	29.4	27.0	.124	.728	....	9.0	S. 67 E.	2.4	......	28.9	68.3	......
January, 1864	1.30	29.279	29.172	25.4	23.0	.107	.680	....	7.4	N. 75 W.	3.4	27.5	....	....	102.1
February, 1864	1.30	29.188	29.076	27.3	24.7	.112	.663	....	8.5	N. 66 W.	3.1	36.3	....	....	80.8
March, 1864	1.30	29.247	29.128	30.7	27.5	.119	.652	....	7.2	N. 39 E.	2.2	68.3	....	55.2	......
April, 1864	1.30	29.369	29.188	40.7	37.4	.181	.716	....	7.5	N. 41 E.	4.3	96.1	....	83.9	......
May, 1864	1.30	29.267	29.015	51.0	46.2	.252	.664	....	7.3	N. 25 E.	2.3	66.0	....	30.0	......
June, 1864	1.30	29.440	29.055	65.5	57.6	.385	.577	....	4.7	S. 86 E.	1.0	......	2.0	28.3	......
July, 1864	1.30	29.410	28.880	72.8	65.3	.530	.655	....	6.5	S. 76 E.	2.0	......	14.2	58.9	......
August, 1864	1.30	29.335	28.797	76.3	66.7	.538	.584	....	6.1	N. 17 W.	2.1	60.5	....	....	18.6
September, 1864	1.30	29.353	28.986	61.5	55.4	.367	.662	....	7.8	N. 40 E.	2.8	63.1	....	53.5	......
October, 1864	1.30	29.290	29.034	49.5	45.4	.256	.712	....	7.8	N. 2 E.	1.0	31.2	....	1.0	......
November, 1864	1.30	29.288	29.122	38.1	24.8	.165	.682	....	8.5	N. 88 W.	3.2	2.9	....	....	94.9
December, 1864	1.30	29.215	29.111	25.4	23.0	.104	.673	....	9.3	N. 88 W.	3.6	2.8	....	....	110.5
January, 1865	1.30	29.321	29.241	22.1	19.4	.080	.611	....	8.5	N. 64 W.	3.4	47.5	....	....	95.9
February, 1865	1.30	29.453	29.353	27.5	24.4	.100	.626	....	8.3	N. 4 W.	1.8	50.7	....	....	3.6
March, 1865	1.30	29.283	29.144	33.9	30.6	.139	.660	....	7.9	N. 55 W.	2.9	50.8	....	....	73.0
April, 1865	1.30	29.362	29.189	43.3	38.3	.173	.613	....	7.8	S. 85 W.	2.0	......	5.9	....	59.7
May, 1865	1.30	29.351	29.130	50.9	44.9	.221	.600	....	5.0	N. 66 E.	1.7	21.3	....	47.3	......
June, 1865	1.30	29.366	28.968	62.4	56.9	.398	.696	....	7.0	S. 21 E.	3.3	......	92.4	36.8	......
July, 1865	1.30	29.402	28.972	67.8	60.4	.430	.634	....	6.2	N. 40 W.	0.9	22.5	....	....	18.0
August, 1865	1.30	29.460	28.985	71.2	63.1	.476	.614	....	5.0	N. 41 E.	0.3	6.4	....	5.4	......
September, 1865	1.30	29.427	28.900	70.0	64.1	.527	.712	....	6.3	S. 2 E.	3.3	......	97.4	3.7	......
October, 1865	1.30	29.385	29.105	51.1	46.9	.280	.697	....	7.4	N. 16 E.	3.0	90.6	....	20.2	......
November, 1865	1.30	29.410	29.223	43.2	38.8	.186	.645	....	7.5	S. 81 W.	2.1	......	9.5	....	61.6
December, 1865	....	......	......	....	....	....	....	....	....	......	....	......	....	....	......
Mean of spring	1.30	29.313	29.132	41.7	37.5	.181	.651	....	7.1	N. 17 E.	1.7	296.6	....	83.7	......
Mean of summer	1.30	29.402	28.943	69.3	61.7	.459	.627	....	5.9	S. 79 E.	0.5	.....	19.2	92.8	......
Mean of autumn	1.30	29.359	29.062	52.2	47.6	.297	.685	....	7.5	N. 45 W.	0.6	80.9	....	....	78.1
Mean of winter	1.30	29.314	29.209	26.2	23.6	.104	.663	....	8.5	N. 69 W.	1.9	135.9	....	....	324.6
Means of all	1.30	29.347	29.086	47.3	42.6	.260	.656	....	7.2	N. 23 W.	0.8	494.2	....	....	226.2
December, 1863	1	29.433	29.310	29.3	26.9	.123	.728	0.10	9.0	S. 78 E.	1.4	......	9.5	43.4	......
January, 1864	1	29.279	29.175	25.3	22.8	.104	.674	....	7.1	N. 80 W.	3.4	18.4	....	....	105.6
February, 1864	1	29.185	29.073	27.0	24.5	.112	.669	0.03	8.1	N. 68 W.	3.5	39.0	....	....	94.3
March, 1864	1	29.253	29.135	30.6	27.5	.118	.652	0.14	7.1	N. 44 E.	2.8	61.4	....	60.5	......
April, 1864	1	29.372	29.191	40.6	37.3	.181	.718	0.03	7.4	N. 42 E.	4.1	90.5	....	82.3	......
May, 1864	1	29.272	29.020	51.1	46.1	.252	.669	....	7.5	N. 29 E.	2.0	53.7	....	29.7	......
June, 1864	1	29.446	29.056	65.8	57.8	.390	.589	0.12	4.4	N. 59 E.	1.9	29.5	....	49.1	......
July, 1864	1	29.413	28.881	72.5	65.2	.532	.662	0.12	6.1	S. 76 E.	2.3	......	17.2	68.3	......
August, 1864	1	29.338	28.789	76.1	66.8	.549	.596	0.03	6.0	N. 18 W.	2.2	64.3	....	....	21.2
September, 1864	1	29.355	28.992	61.1	55.0	.362	.659	0.12	7.9	N. 19 E.	2.0	56.7	....	19.8	......
October, 1864	1	28.294	29.036	49.2	45.4	.258	.720	0.27	7.8	N. 12 W.	1.6	48.5	....	....	10.5
November, 1864	1	29.291	29.126	37.8	34.5	.165	.702	0.12	8.0	S. 87 W.	3.4	......	4.6	....	102.9
December, 1864	1	29.217	29.112	25.3	22.9	.105	.676	0.24	9.1	N. 85 W.	4.0	10.8	....	....	123.1
January, 1865	1	29.329	29.250	21.8	19.1	.079	.617	0.04	8.6	N. 62 W.	3.5	51.7	....	....	95.0
February, 1865	1	29.456	29.256	27.0	24.1	.100	.637	0.10	8.4	N. 13 E.	1.8	50.8	....	11.6	......
March, 1865	1	29.289	29.153	33.6	30.3	.137	.660	0.11	8.1	N. 65 W.	1.9	24.6	....	....	53.9
April, 1865	1	29.363	29.186	43.1	38.4	.177	.629	0.05	7.8	S. 89 W.	2.5	......	1.1	....	75.0
May, 1865	1	29.352	29.125	50.7	44.9	.227	.612	0.09	4.8	N. 62 E.	1.6	23.3	....	43.5	......
June, 1865	1	29.371	28.974	62.2	56.8	.397	.700	0.12	6.9	S. 13 E.	1.9	......	57.8	13.5	......
July, 1865	1	29.404	28.974	67.6	60.4	.430	.637	....	6.4	N. 53 W.	0.7	13.7	....	....	17.3
August, 1865	1	29.462	28.984	71.1	63.1	.478	.621	....	5.0	N. 13 W.	0.5	15.0	....	....	3.4
September, 1865	1	29.436	28.907	69.8	64.1	.529	.718	0.29	6.0	S. 5 E.	3.3	......	9.9	8.6	......
October, 1865	1	29.388	29.111	50.7	46.5	.277	.699	0.09	7.4	N. 28 E.	3.6	98.2	....	53.5	......
November, 1865	1	29.415	29.229	42.9	38.6	.186	.649	....	7.6	N. 80 W.	2.1	10.2	....	....	60.3
December, 1865	....	......	......	....	....	....	....	....	....	......	....	......	....	....	......
Mean of spring	1	29.317	29.135	41.6	37.4	.183	.657	0.42	7.1	N. 19 E.	1.5	252.4	....	87.1	......
Mean of summer	1	29.406	28.943	69.2	61.7	.463	.634	0.39	5.8	N. 59 E.	0.6	47.5	....	89.0	......
Mean of autumn	1	29.363	29.067	51.8	47.3	.296	.691	0.89	7.5	N. 40 W.	0.8	109.1	....	....	91.8
Mean of winter	1	29.316	29.213	25.9	23.4	.104	.667	0.51	8.4	N. 66 W.	2.2	161.2	....	....	363.0
Means of all	1	29.350	29.089	47.1	42.4	.261	.662	2.21	7.2	N. 26 W.	0.9	570.2	....	....	278.7

Meteorological observations at Thunder Bay Island, &c.—Continued.

Date.	Time of observation.	Pressure reduced to 32° Fahr.: Total U. S. inches and decimals.	Pressure reduced to 32° Fahr.: Gaseous, U. S. inches and decimals.	Temp., Fahr.: Dry bulb.	Temp., Fahr.: Wet bulb.	Vapor: Elasticity, U. S. inches and decimals.	Vapor: Humidity. Saturation = 1.000.	Am't of rain and melted snow, U. S. inches and decimals.	Am't cloudiness. (10=sky entirely overcast, 0=clear sky.)	Wind: Observed direction; from whence.	Wind: Observed velocity; miles per hour.	Resolution of direction and velocity, in miles per hour: N.	S.	E.	W.
	P. M.			°	°					°					
December, 1863	0.30	29.442	29.320	29.0	26.7	.122	.728	....	9.0	S. 75 E.	1.8	......	14.7	55.1	....
January, 1864	0.30	29.285	29.182	25.1	22.6	.103	.680	....	7.2	N. 79 W.	3.2	19.2	....	....	92.0
February, 1864	0.30	29.188	29.076	26.8	24.2	.112	.674	....	8.9	N. 61 W.	3.2	45.5	....	....	53.1
March, 1864	0.30	29.262	29.142	30.5	27.5	.120	.665	....	7.4	N. 43 E.	2.5	55.2	....	51.8	....
April, 1864	0.30	29.372	29.190	40.6	37.4	.182	.722	....	7.5	N. 48 E.	3.9	80.3	....	67.7	....
May, 1864	0.30	29.278	29.023	50.9	46.1	.255	.680	....	7.8	N. 11 E.	1.7	53.3	....	10.1	....
June, 1864	0.30	29.448	29.055	65.6	57.5	.393	.602	....	4.2	N. 63 E.	1.7	23.1	....	44.8	....
July, 1864	0.30	29.416	28.884	72.3	65.1	.532	.668	....	6.0	S. 75 E.	2.2	......	18.2	66.8	....
August, 1864	0.30	29.340	28.791	75.6	66.7	.549	.611	....	6.0	N. 16 W.	2.2	64.6	....	....	17.9
September, 1864	0.30	29.358	28.993	60.7	54.9	.365	.670	....	2.1	N. 29 E.	1.9	50.4	....	28.2	....
October, 1864	0.30	29.300	29.040	48.9	45.2	.260	.735	....	7.9	N. 17 W.	1.9	55.0	....	....	17.3
November, 1864	0.30	29.295	29.132	37.4	34.2	.163	.702	....	8.8	S. 89 W.	3.7	......	2.3	....	110.0
December, 1864	0.30	29.222	29.115	25.2	22.9	.107	.696	....	9.0	N. 83 W.	3.5	13.0	....	....	109.3
January, 1865	0.30	29.333	29.256	21.4	18.7	.078	.619	....	8.9	N. 59 W.	3.7	57.5	....	....	97.4
February, 1865	0.30	29.461	29.362	26.6	23.7	.099	.647	....	8.6	N. 10 E.	1.6	43.5	....	7.6	....
March, 1865	0.30	29.294	29.157	33.3	30.2	.137	.669	....	8.0	N. 82 W.	2.2	9.4	....	....	66.7
April, 1865	0.30	29.363	29.184	42.8	38.3	.179	.640	....	7.8	N. 84 W.	2.9	8.6	....	....	86.4
May, 1865	0.30	29.359	29.132	50.4	44.7	.227	.619	....	4.9	N. 68 E.	1.1	22.3	....	54.5	....
June, 1865	0.30	29.375	28.978	62.9	57.1	.397	.707	....	7.1	S. 9 E.	2.7	......	81.6	13.2	....
July, 1865	0.30	29.407	28.978	67.5	60.2	.429	.640	....	6.0	N. 47 W.	0.6	13.5	....	....	14.2
August, 1865	0.30	29.465	28.988	70.7	63.0	.477	.624	....	5.0	N. 11 W.	0.6	16.6	....	....	2.2
September, 1865	0.30	29.440	28.913	67.4	63.8	.527	.726	....	5.9	S. 8 E.	3.1	......	93.7	12.9	....
October, 1865	0.30	29.390	29.116	50.3	46.2	.274	.709	....	7.6	N. 22 E.	3.4	99.0	....	40.9	....
November, 1865	0.30	29.418	29.234	42.6	38.4	.185	.653	....	7.8	N. 82 W.	2.3	9.5	....	....	66.9
December, 1865	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Mean of spring	0.30	29.321	29.138	41.4	37.4	.183	.666	....	7.1	N. 14 E.	1.2	229.1	....	51.0	....
Mean of summer	0.30	29.408	29.946	68.9	61.6	.463	.642	....	5.7	N. 79 E.	0.5	18.0	....	89.5	....
Mean of autumn	0.30	29.367	29.071	51.5	47.1	.296	.699	....	7.7	N. 45 W.	0.8	117.8	....	....	112.9
Mean of winter	0.30	29.322	29.218	25.7	23.1	.103	.674	....	8.6	N. 63 W.	2.0	164.0	....	....	325.1
Means of all	0.30	29.354	29.093	46.9	42.3	.261	.670	....	7.3	N. 30 W.	0.8	528.9	....	....	296.8
December, 1863	12	29.449	29.329	28.9	26.5	.120	.729	0.22	8.9	S. 68 E.	1.7	......	29.9	50.2	....
January, 1864	12	29.291	29.190	24.7	22.3	.101	.682	0.12	7.5	N. 86 W.	3.4	7.9	....	....	105.8
February, 1864	12	29.196	29.085	26.3	23.9	.111	.675	0.04	8.7	N. 56 W.	3.2	54.2	....	....	78.6
March, 1864	12	29.268	29.146	30.5	27.5	.122	.674	0.18	7.6	N. 37 E.	2.1	52.9	....	40.1	....
April, 1864	12	29.373	29.189	40.4	37.3	.184	.734	0.05	7.4	N. 52 E.	4.7	87.0	....	112.6	....
May, 1864	12	29.279	29.025	50.6	45.9	.254	.687	0.06	7.8	N. 3 E.	2.0	63.2	....	3.4	....
June, 1864	12	29.451	29.049	65.2	57.2	.402	.636	....	4.2	N. 51 E.	1.5	28.5	....	35.2	....
July, 1864	12	29.428	28.889	72.0	65.0	.531	.674	....	5.7	S. 82 E.	1.8	......	7.4	55.5	....
August, 1864	12	29.342	28.793	75.0	66.5	.549	.622	0.04	6.2	N. 24 W.	3.0	86.8	....	....	35.3
September, 1864	12	29.359	28.986	60.6	55.1	.373	.690	0.17	8.2	N. 27 E.	2.0	54.1	....	27.9	....
October, 1864	12	29.304	29.042	48.4	45.0	.262	.748	0.06	7.9	N. 14 W.	1.5	46.0	....	....	11.1
November, 1864	12	29.296	29.132	37.1	34.1	.163	.713	0.04	8.9	S. 89 W.	3.8	......	2.9	....	113.5
December, 1864	12	29.229	29.121	25.0	22.5	.108	.701	0.21	9.1	N. 81 W.	4.7	23.0	....	....	144.4
January, 1865	12	29.339	29.262	20.9	18.4	.077	.624	0.03	9.1	N. 61 W.	3.8	57.5	....	....	103.2
February, 1865	12	29.465	29.367	26.1	23.3	.098	.643	0.04	9.0	N. 11 E.	2.2	59.3	....	11.5	....
March, 1865	12	29.299	29.164	32.5	29.7	.135	.671	0.08	8.1	N. 78 W.	2.2	14.3	....	....	65.0
April, 1865	12	29.364	29.186	42.5	38.2	.178	.642	0.09	7.7	N. 89 W.	3.1	1.8	....	....	92.2
May, 1865	12	29.361	29.132	50.4	44.8	.229	.623	0.13	4.1	N. 77 E.	2.3	16.2	....	71.8	....
June, 1865	12	29.376	28.979	61.8	56.7	.397	.710	....	7.2	S. 3 E.	2.5	......	75.2	3.5	....
July, 1865	12	29.409	28.975	67.4	60.4	.434	.648	....	6.1	N. 28 W.	0.1	2.6	....	....	1.3
August, 1865	12	29.468	29.989	70.2	62.8	.479	.645	....	5.1	N. 2 E.	0.5	16.0	....	0.7	....
September, 1865	12	29.447	28.921	69.1	63.7	.526	.731	0.28	5.8	S. 15 E.	2.8	......	80.7	21.6	....
October, 1865	12	29.394	29.122	49.7	45.9	.272	.717	0.09	7.8	N. 11 E.	2.5	76.1	....	15.0	....
November, 1865	12	29.423	29.239	42.1	38.1	.184	.664	....	8.1	N. 80 W.	2.3	11.2	....	....	67.1
December, 1865	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Mean of spring	12	29.324	29.140	41.1	37.2	.184	.672	0.59	7.1	N. 17 E.	1.4	235.4	....	70.7	....
Mean of summer	12	29.412	28.946	68.6	61.4	.465	.656	0.04	5.7	N. 45 E.	0.4	51.3	....	58.3	....
Mean of autumn	12	29.370	29.074	51.2	47.0	.296	.710	0.64	7.8	N. 49 W.	0.9	103.8	....	....	127.2
Mean of winter	12	29.328	29.226	25.3	22.8	.102	.676	0.76	8.7	N. 63 W.	2.3	181.0	....	....	370.3
Means of all	12	29.359	29.096	46.5	42.1	.262	.678	2.03	7.3	N. 32 W.	0.9	571.5	....	....	368.5

Meteorological observations at Thunder Bay Island, &c.—Continued.

Date.	Time of observation.	Pressure reduced to 32° Fahr. Total, U. S. inches and decimals.	Pressure reduced to 32° Fahr. Gaseous, U. S. inches and decimals.	Temp., Fahr. Dry bulb.	Temp., Fahr. Wet bulb.	Vapor. Elasticity, U. S. inches and decimals.	Vapor. Humidity. Saturation = 1.000.	Am't of rain and melted snow, U. S. inches and decimals.	Am't cloudiness. (10=sky entirely overcast, 0=clear sky.)	Wind. Observed direction; from whence.	Wind. Observed velocity; miles per hour.	Resolution of direction and velocity, in miles per hour. N.	S.	E.	W.
	A. M.			°	°					°					
December, 1863	11.30	29.456	29.340	28.5	26.2	.116	.718	....	8.8	S. 69 E.	1.9	.....	17.7	45.8	.....
January, 1864	11.30	29.300	29.198	24.1	21.8	.102	.705	....	7.8	N. 89 W.	2.5	1.0	....	.....	79.6
February, 1864	11.30	29.199	29.090	25.7	23.4	.109	.676	....	8.8	N. 57 W.	3.9	56.6	....	.....	87.0
March, 1864	11.30	29.266	29.145	30.1	27.2	.121	.677	....	7.4	N. 48 E.	2.0	42.1	....	46.5	.....
April, 1864	11.30	29.373	29.188	40.2	37.2	.185	.742	....	7.3	N. 57 E.	3.9	63.1	....	99.4	.....
May, 1864	11.30	29.280	29.026	49.9	45.6	.254	.702	....	7.5	N. 3 E.	2.4	78.4	....	3.9	.....
June, 1864	11.30	29.453	29.049	64.6	57.3	.403	.644	....	3.8	N. 36 E.	1.5	37.6	....	27.8	.....
July, 1864	11.30	29.421	28.881	71.6	64.9	.540	.686	....	5.7	S. 87 E.	1.7	.....	2.0	52.4	.....
August, 1864	11.30	29.343	28.788	74.5	66.5	.555	.639	....	5.8	N. 26 W.	3.5	96.0	....	.....	49.2
September, 1864	11.30	29.361	28.989	60.0	54.9	.372	.702	....	8.3	N. 19 E.	2.3	66.5	....	23.3	.....
October, 1864	11.30	29.309	29.053	47.8	44.5	.257	.758	....	8.0	N. 24 W.	1.6	43.4	...	.....	19.2
November, 1864	11.30	29.300	29.137	36.9	33.9	.163	.718	....	8.9	S. 83 W.	3.1	.....	10.9	.....	92.5
December, 1864	11.30	29.235	29.130	24.9	22.6	.105	.692	....	9.0	N. 85 W.	3.9	11.5	....	.....	127.7
January, 1865	11.30	29.345	29.268	20.4	18.0	.077	.638	....	9.1	N. 57 W.	4.1	69.5	....	.....	105.5
February, 1865	11.30	29.468	29.370	25.6	22.9	.098	.658	....	9.2	N. 10 E.	2.0	56.2	....	9.6	.....
March, 1865	11.30	29.301	29.165	32.5	29.6	.136	.686	....	7.9	N. 69 W.	2.2	23.1	....	.....	62.8
April, 1865	11.30	29.364	29.185	42.3	38.0	.179	.651	....	7.7	S. 86 W	3.3	.....	6.3	.....	98.5
May, 1865	11.30	29.364	29.137	50.3	44.8	.227	.629	....	4.8	S. 87 E.	2.2	.....	3.7	67.5	.....
June, 1865	11.30	29.380	28.983	61.7	56.6	.397	.713	....	7.1	S. 18 E	2.3	.....	65.1	21.4	.....
July, 1865	11.30	29.411	28.978	67.0	60.2	.433	.655	....	6.0	N. 24 W.	0.5	14.6	....	.....	6.1
August, 1865	11.30	29.471	29.000	69.4	61.9	.471	.647	....	5.1	N. 20 W.	0.8	23.7	....	.....	8.3
September, 1865	11.30	29.452	28.932	68.4	63.2	.520	.742	....	6.0	S. 10 E.	2.6	.....	77.3	13.3	.....
October, 1865	11.30	29.397	29.131	49.0	45.2	.266	.726	....	7.8	N. 20 E	2.6	76.3	....	28.5	.....
November, 1865	11.30	29.428	29.246	41.6	37.7	.182	.669	....	8.2	N. 75 W.	2.5	18.3	....	.....	70.7
December, 1865	11.30	.....	.....	....	....	....	....	....	....	.....	....	.....	....	.....	.....
Mean of spring	11.30	29.325	29.141	40.9	37.1	.184	.681	....	7.1	N. 15 E.	1.1	196.7	....	56.0	.....
Mean of summer	11.30	29.415	28.946	68.1	61.2	.466	.664	....	5.6	N. 22 E.	0.5	104.8	....	38.0	.....
Mean of autumn	11.30	29.374	29.081	50.6	46.6	.293	.719	....	7.9	N. 45 W.	0.9	116.3	....	.....	117.3
Mean of winter	11.30	26.334	29.233	24.8	22.5	.101	.681	....	8.8	N. 62 W.	2.2	177.1	....	.....	344.4
Means of all	11.30	29.362	29.100	46.1	41.9	.261	.686	....	7.3	N. 32 W.	0.9	594.9	....	.....	367.7
December, 1863	11	29.456	29.339	28.1	25.8	.117	.729	0.30	8.9	S. 66 E.	2.0	.....	26.7	58.8	.....
January, 1864	11	29.305	29.204	23.3	21.2	.101	.712	0.09	7.8	N. 89 W.	3.0	1.9	....	.....	93.1
February, 1864	11	29.203	29.094	25.2	22.2	.109	.696	0.02	8.5	N. 58 W.	3.3	52.4	....	.....	82.7
March, 1864	11	29.269	29.149	20.5	26.7	.119	.685	0.06	7.4	N. 46 E.	2.1	45.6	....	47.1	.....
April, 1864	11	29.377	29.192	39.9	37.1	.185	.754	....	7.4	N. 61 E.	4.0	58.4	....	105.0	.....
May, 1864	11	29.283	29.030	49.5	45.3	.253	.710	0.05	7.6	N. 9 E.	2.2	68.4	....	10.3	.....
June, 1864	11	29.455	29.058	64.2	57.0	.397	.634	....	3.6	N. 19 E.	1.9	54.3	....	19.2	.....
July, 1864	11	29.424	28.888	71.2	64.7	.537	.696	0.03	5.2	S. 50 E.	1.6	.....	32.4	38.5	.....
August, 1864	11	29.346	28.787	74.1	66.4	.559	.661	....	5.9	N. 31 W	2.9	78.7	....	....	45.3
September, 1864	11	29.370	28.997	59.6	54.7	.372	.716	0.19	8.5	N. 19 E.	2.7	75.6	....	26.6	.....
October, 1864	11	29.312	29.058	47.4	44.3	.254	.763	0.08	8.0	N. 32 W.	1.7	45.6	....	.....	28.7
November, 1864	11	29.305	29.142	36.5	33.7	.163	.728	0.17	8.8	S. 84 W.	3.7	.....	10.3	.....	111.4
December, 1864	11	29.242	29.137	24.6	22.4	.105	.698	0.23	8.9	N. 87 W.	3.7	5.4	....	.....	114.2
January, 1865	11	29.349	29.273	19.9	17.6	.076	.642	0.07	9.1	N. 55 W.	4.0	70.9	....	.....	102.5
February, 1865	11	29.469	29.372	24.9	22.4	.097	.671	0.07	9.3	N. 5 E.	1.8	51.3	....	4.2	.....
March, 1865	11	29.304	29.167	32.1	29.3	.137	.697	0.11	7.8	N. 64 W.	1.9	26.0	....	.....	53.4
April, 1865	11	29.365	29.185	41.8	37.8	.179	.663	0.11	7.5	S. 87 W.	3.1	.....	5.2	.....	93.5
May, 1865	11	29.364	29.133	50.1	44.7	.231	.637	0.12	5.0	N. 88 E.	2.2	2.2	....	67.1	.....
June, 1865	11	29.382	28.982	61.5	56.6	.400	.722	0.04	7.0	S. 11 E.	2.7	.....	80.9	15.5	.....
July, 1865	11	29.411	28.979	66.6	60.1	.434	.663	....	6.3	N. 22 W.	0.7	19.7	....	.....	7.1
August, 1865	11	29.477	29.002	68.6	61.9	.475	.662	....	4.9	N. 30 W.	0.7	19.4	....	.....	10.9
September, 1865	11	29.458	28.940	67.7	62.9	.518	.755	0.25	6.0	S. 10 W.	2.5	.....	73.2	.....	13.2
October, 1865	11	29.400	29.137	48.3	44.8	.273	.734	0.09	7.9	N. 17 E.	2.8	84.5	....	26.2	.....
November, 1865	11	29.430	29.247	41.0	37.4	.183	.687	....	8.4	N. 76 W.	2.6	18.2	....	.....	71.3
December, 1865	11	.....	.....	....	....	....	....	....	....	.....	....	.....	....	.....	.....
Mean of spring	11	29.327	29.143	40.5	36.8	.184	.691	0.45	7.1	N. 24 E.	1.2	195.4	....	82.5	.....
Mean of summer	11	29.416	28.949	67.7	61.1	.467	.671	0.07	5.5	N. 18 E.	0.3	58.8	....	9.9	.....
Mean of autumn	11	29.379	29.087	50.1	46.3	.294	.730	0.78	7.9	N. 48 W.	1.2	140.4	....	.....	171.8
Mean of winter	11	29.337	29.236	24.3	21.9	.101	.691	0.78	8.7	N. 66 W.	1.9	155.2	....	.....	329.5
Means of all	11	29.364	29.104	45.6	41.5	.261	.696	2.08	7.3	N. 37 W.	1.0	549.8	....	.....	408.9

Meteorological observations at Thunder Bay Island, &c.—Continued.

Date.	Time of observation.	Pressure reduced to 32° Fahr.		Temp., Fahr.		Vapor.		Am't of rain and melted snow, U. S. inches and decimals.	Am't cloudiness. (10=sky entirely overcast, 0=clear sky.)	Wind.					
		Total, U. S. inches and decimals.	Gaseous, U. S. inches and decimals.	Dry bulb.	Wet bulb.	Elasticity, U. S. inches and decimals.	Humidity. Saturation = 1.000.			Observed direction; from whence.	Observed velocity; miles per hour.	Resolution of direc and velocity, in mi per hour. N.	S.	E.	W.
	A. M.			°	°					°					
December, 1863	10.30	29.464	29.349	27.7	25.4	.115	.726	....	8.7	S. 76 E.	1.9	......	14.5	57.6	......
January, 1864	10.30	29.310	29.211	22.7	20.7	.099	.703	....	7.6	S. 89 W.	3.3	......	2.1	......	[illegible]
February, 1864	10.30	29.204	29.099	24.5	22.3	.106	.697	....	8.7	N. 59 W.	3.1	45.9	....	......	76.5
March, 1864	10.30	29.271	29.154	28.9	26.1	.117	.687	....	7.5	N. 44 E.	2.5	55.1	....	52.9	......
April, 1864	10.30	29.377	29.195	39.5	36.7	.182	.750	....	7.6	N. 60 E.	4.0	61.4	....	104.3	......
May, 1864	10.30	24.282	29.027	49.3	45.3	.255	.723	....	7.6	N. 10 E.	2.1	64.1	....	11.3	......
June, 1864	10.30	29.455	29.065	63.7	56.6	.390	.614	....	3.7	N. 20 W.	1.6	43.4	....	......	16.5
July, 1864	10.30	29.426	28.896	70.7	64.5	.530	.700	....	5.3	East	0.8	......	0.1	23.9	......
August, 1864	10.30	29.345	28.793	73.1	65.9	.552	.665	....	5.9	N. 28 W.	2.7	73.6	....	......	41.2
September, 1864	10.30	29.374	29.005	59.0	54.3	.369	.722	....	8.3	N. 52 E.	2.1	38.7	....	50.0	......
October, 1864	10.30	29.314	29.065	46.6	43.6	.249	.767	....	8.2	N. 35 W.	2.1	52.0	....	......	[illegible]
November, 1864	10.30	29.308	29.145	36.1	33.4	.163	.738	....	8.8	S. 86 W.	3.9	......	7.4	......	117.7
December, 1864	10.30	29.247	29.144	24.0	22.0	.103	.703	....	9.0	S. 85 W.	3.9	......	10.1	......	[illegible]
January, 1865	10.30	29.354	29.280	19.4	17.1	.074	.644	....	9.3	N. 52 W.	4.1	77.9	....	......	101.8
February, 1865	10.30	29.469	29.373	24.3	22.0	.096	.683	....	9.1	N. 3 W.	1.8	51.1	....	3.0	......
March, 1865	10.30	29.307	29.169	31.7	29.1	.138	.714	....	7.9	N. 65 W.	2.6	35.3	....	......	74.1
April, 1865	10.30	29.366	29.186	41.2	37.4	.180	.674	....	7.3	N. 83 W.	3.3	12.2	....	....	98.5
May, 1865	10.30	29.366	29.130	49.7	44.7	.236	.659	....	4.7	N. 79 E.	2.0	11.1	....	58.8	......
June, 1865	10.30	29.384	28.983	61.2	56.5	.401	.731	....	6.9	S. 11 E.	2.3	......	68.0	13.6	......
July, 1865	10.30	29.415	28.986	66.1	59.8	.429	.671	....	6.4	N. 25 W.	1.2	34.8	....	......	16.3
August, 1865	10.30	29.475	29.008	67.9	61.5	.467	.677	....	4.7	N. 20 W.	0.8	24.1	....	......	[illegible]
September, 1865	10.30	29.459	28.942	67.0	62.6	.517	.781	....	5.7	S. 7 E.	2.2	......	65.5	7.8	......
October, 1865	10.30	29.402	29.144	47.6	44.2	.258	.739	....	6.1	N. 5 E.	2.9	90.1	....	8.8	......
November, 1865	10.30	29.431	29.250	40.5	37.0	.181	.693	....	8.6	N. 74 W.	3.3	25.9	....	......	92.7
December, 1865	.....	......	......	....	....	....	....	....	....	....	....	......	....	....	......
Mean of spring	10.30	29.328	29.143	40.0	36.5	.185	.701	....	7.1	N. 13 E.	1.3	239.2	....	54.5	......
Mean of summer	10.30	29.417	28.955	67.1	60.8	.461	.676	....	5.5	N. 22 W.	0.5	107.8	....	......	45.6
Mean of autumn	10.30	29.381	29.092	49.5	45.8	.292	.740	....	7.9	N. 55 W.	1.2	133.8	....	......	180.7
Mean of winter	10.30	29.341	29.243	23.8	21.6	.099	.693	....	8.7	N. 67 W.	2.1	148.2	....	......	338.5
Means of all	10.30	29.367	29.108	45.1	41.2	.259	.702	....	7.3	N. 38 W.	1.1	629.0	....	......	511.1
December, 1863	10	29.465	29.349	27.3	25.2	.116	.742	0.25	8.7	S. 81 E.	3.2	......	16.4	98.7	......
January, 1864	10	29.315	29.218	22.0	20.1	.097	.721	0.08	7.7	S. 84 W.	3.4	......	11.3	......	[illegible]
February, 1864	10	29.198	29.092	23.9	21.9	.106	.712	0.09	8.8	N. 79 W.	3.0	15.9	....	......	[illegible]
March, 1864	10	29.276	29.159	28.1	25.6	.116	.708	0.15	7.2	N. 48 E.	2.5	51.4	....	56.9	......
April, 1864	10	29.381	29.200	39.2	36.5	.181	.757	0.02	7.9	N. 54 E.	3.9	68.8	....	93.9	......
May, 1864	10	29.284	29.032	48.7	44.9	.252	.729	....	7.2	N. 10 E.	2.6	78.2	....	14.5	......
June, 1864	10	29.454	29.066	63.2	56.5	.388	.635	....	4.1	N. 21 W.	1.1	31.6	....	......	12.0
July, 1864	10	29.427	28.892	70.3	64.5	.535	.718	....	5.0	N. 85 E.	0.5	1.6	....	16.0	......
August, 1864	10	29.347	28.797	72.3	65.6	.550	.682	0.02	6.0	N. 32 W.	2.8	73.7	....	......	47.9
September, 1864	10	29.366	28.998	58.4	54.0	.367	.734	0.24	8.0	N. 70 E.	2.6	26.9	....	72.2	......
October, 1864	10	29.314	29.067	45.9	43.1	.246	.779	0.02	8.3	N. 30 W.	2.2	59.8	....	......	34.2
November, 1864	10	29.309	29.148	35.7	33.1	.161	.742	0.08	9.1	S. 85 W.	3.9	......	10.2	......	115.9
December, 1864	10	29.251	29.146	23.8	21.9	.105	.711	0.27	9.1	S. 86 W.	3.4	......	7.8	......	105.4
January, 1865	10	29.356	29.282	18.9	16.7	.074	.651	0.03	9.2	N. 49 W.	3.5	71.6	....	......	82.1
February, 1865	10	29.469	29.377	23.6	21.3	.092	.678	0.04	9.2	N. 1 W.	2.2	62.4	....	......	6.1
March, 1865	10	29.308	29.171	31.2	28.8	.137	.722	0.17	7.8	N. 62 W.	2.3	34.0	....	......	[illegible]
April, 1865	10	29.366	29.189	40.4	36.9	.177	.690	0.14	7.4	N. 77 W.	2.2	14.5	....	......	65.4
May, 1865	10	29.371	29.138	49.2	44.3	.233	.663	....	4.8	N. 87 E.	2.0	3.6	....	60.5	......
June, 1865	10	29.385	28.983	60.8	56.3	.402	.744	0.05	6.8	S. 14 E.	2.3	......	67.2	16.6	......
July, 1865	10	29.414	28.983	65.5	59.5	.431	.683	....	6.5	N. 37 W.	1.7	43.5	....	......	32.0
August, 1865	10	29.475	29.008	67.0	61.2	.467	.697	....	4.6	N. 14 W.	0.9	28.1	....	......	7.0
September, 1865	10	29.460	28.946	66.2	62.2	.514	.786	0.28	5.6	S. 9 E.	2.2	......	64.9	10.0	......
October, 1865	10	29.404	29.150	47.0	43.7	.254	.746	0.09	7.8	N. 2 W.	3.0	93.1	....	......	3.6
November, 1865	10	29.426	29.246	40.2	36.8	.180	.706	....	8.4	N. 68 W.	3.9	43.0	....	......	104.4
December, 1865	.....	......	......	....	....	....	....	....	....	....	....	......	....	....	......
Mean of spring	10	29.331	29.148	39.5	36.2	.183	.711	0.48	7.0	N. 20 E.	1.5	250.5	....	97.4	......
Mean of summer	10	29.417	28.955	66.5	60.6	.462	.693	0.07	5.5	N. 26 W.	0.7	111.3	....	......	65.3
Mean of autumn	10	29.380	29.092	48.9	45.5	.287	.749	0.71	7.9	N. 51 W.	1.3	147.7	....	......	175.5
Mean of winter	10	29.342	29.244	23.2	21.2	.098	.702	0.76	8.8	N. 68 W.	1.6	114.4	....	......	[illegible]
Means of all	10	29.367	29.110	44.5	40.9	.257	.714	2.02	7.3	N. 41 W.	1.1	629.9	....	......	425.1

Meteorological observations at Thunder Bay Island, &c.—Continued.

Date.	Time of observation.	Pressure reduced to 32° Fahr.		Temp., Fahr.		Vapor.		Am't of rain and melted snow, U. S inches and decimals.	Am't cloudiness. (10=sky entirely overcast, 0=clear sky.)	Wind.					
		Total, U. S. inches and decimals.	Gaseous, U. S. inches and decimals.	Dry bulb.	Wet bulb.	Elasticity, U. S. inches and decimals.	Humidity. Saturation = 1.000.			Observed direction; from whence.	Observed velocity; miles per hour.	Resolution of direction and velocity, in miles per hour.			
												N.	S.	E.	W.
	A.M.			°	°					°					
December, 1863	9.30	29.467	29.355	26.9	24.7	.113	.736	....	8.9	N. 87 E.	3.0	4.7	....	91.4	....
January, 1864	9.30	29.312	29.216	21.5	19.6	.096	.729	....	4.7	S. 81 W.	3.3	....	15.8	....	102.4
February, 1864	9.30	29.201	29.096	23.4	21.5	.105	.713	....	8.7	N. 74 W.	3.1	25.7	....	....	86.3
March, 1864	9.30	29.272	29.158	27.2	24.9	.114	.714	....	7.2	N. 48 E.	2.2	45.8	....	50.5	....
April, 1864	9.30	29.377	29.197	38.8	36.2	.180	.765	....	7.8	N. 52 E.	3.7	69.3	....	88.6	....
May, 1864	9.30	29.285	29.033	48.2	44.6	.252	.743	....	7.3	N. 2 W.	2.7	83.2	....	....	3.1
June, 1864	9.30	29.456	29.073	62.8	58.5	.383	.657	....	4.5	North	2.3	68.7	....	0.5	....
July, 1864	9.30	29.426	28.898	69.4	64.0	.529	.729	....	5.0	N. 18 W.	0.1	6.1	....	....	2.1
August, 1864	9.30	29.347	28.797	71.4	65.2	.550	.703	....	6.1	N. 34 W.	2.6	70.3	....	....	47.2
September, 1864	9.30	29.362	28.997	57.7	53.6	.364	.746	....	7.9	N. 74 E.	2.6	21.2	....	76.1	....
October, 1864	9.30	29.315	29.073	45.0	42.4	.242	.790	....	8.5	N. 34 W.	2.4	62.0	....	....	41.6
November, 1864	9.30	29.310	29.150	35.2	32.7	.160	.750	....	9.2	S. 84 W.	4.1	....	13.5	....	122.6
December, 1864	9.30	29.251	29.148	23.6	21.5	.103	.708	....	9.3	N. 88 W.	3.8	4.5	....	....	117.8
January, 1865	9.30	29.358	29.285	18.4	16.2	.073	.654	....	9.1	N. 57 W.	3.4	57.6	....	....	87.3
February, 1865	9.30	29.466	29.375	23.1	20.8	.091	.689	....	9.2	N. 1 W.	2.5	68.8	....	....	1.1
March, 1865	9.30	29.310	29.176	30.6	28.2	.134	.722	....	7.9	N. 54 W.	2.4	43.1	....	....	59.4
April, 1865	9.30	29.364	29.190	39.6	36.2	.174	.703	....	7.6	N. 83 W.	2.2	8.4	....	....	64.1
May, 1865	9.30	29.364	22.132	48.7	44.0	.232	.672	....	4.1	East	1.6	0.4	....	50.9	....
June, 1865	9.30	29.386	28.985	60.2	56.1	.401	.757	....	7.0	S. 6 E.	2.4	....	71.5	7.0	....
July, 1865	9.30	29.416	28.982	65.0	59.3	.434	.701	....	6.8	N. 38 W.	1.7	41.6	....	....	32.1
August, 1865	9.30	29.474	29.012	66.2	60.7	.462	.709	....	4.8	N. 11 W.	1.2	36.4	....	....	7.2
September, 1865	9.30	29.460	28.946	65.6	61.9	.514	.803	....	5.4	S. 15 W.	2.1	....	60.1	....	16.0
October, 1865	9.30	29.406	29.157	46.4	43.2	.249	.748	....	7.8	N. 13 W.	2.4	73.2	....	....	16.3
November, 1865	9.30	29.427	29.249	39.5	36.3	.178	.702	....	8.7	N. 81 W.	4.2	18.4	....	....	121.5
December, 1865	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Mean of spring	9.20	29.329	29.148	38.8	35.7	.181	.720	....	7.0	N. 12 E.	1.4	250.2	....	63.4	....
Mean of summer	9.30	29.417	28.957	65.8	60.3	.460	.716	....	5.7	N. 26 W.	0.9	151.6	....	....	81.1
Mean of autumn	9.30	29.380	29.095	48.2	45.0	.285	.756	....	7.9	N. 65 W.	1.4	101.2	....	....	241.9
Mean of winter	9.30	29.342	29.246	22.8	20.7	.097	.705	....	8.3	N. 65 W.	1.9	145.5	....	....	303.5
Means of all	9.30	29.367	29.111	43.9	40.4	.256	.724	....	7.2	N. 42 W.	1.2	648.5	....	....	573.1
December, 1863	9	29.471	29.359	26.6	24.5	.112	.742	0.30	8.8	S. 89 E	3.3	....	2.0	104.6	....
January, 1864	9	29.307	29.213	20.9	19.2	.094	.730	0.11	7.5	S. 74 W.	3.5	....	30.5	....	104.7
February, 1864	9	29.201	29.096	23.0	21.1	.105	.717	0.09	8.6	N. 88 W.	2.7	2.0	....	....	80.9
March, 1864	9	29.272	29.160	26.3	24.1	.111	.717	0.08	7.0	N. 47 E.	2.2	46.2	....	49.5	....
April, 1864	9	29.373	29.195	38.4	35.9	.178	.770	0.02	7.8	N. 55 E.	3.6	60.9	....	87.5	....
May, 1864	9	29.287	29.037	47.7	44.2	.250	.752	0.07	7.4	N. 5 E.	2.6	80.8	....	7.4	....
June, 1864	9	29.456	29.065	62.0	56.4	.390	.669	....	4.2	N. 17 W.	1.2	34.2	....	....	10.1
July, 1864	9	29.428	29.095	68.6	63.5	.523	.743	0.02	4.5	N. 19 W.	0.8	22.3	....	....	7.0
August, 1864	9	29.345	28.794	70.7	65.0	.551	.725	....	6.1	N. 29 W.	2.9	77.3	....	....	44.6
September, 1864	9	29.362	28.998	57.2	53.3	.363	.761	0.12	7.6	S. 85 E	2.4	....	6.9	69.8	....
October, 1864	9	29.315	29.078	44.3	41.8	.237	.799	0.10	8.2	N. 32 W.	2.9	74.8	....	....	46.6
November, 1864	9	29.309	29.149	34.9	32.5	.160	.762	0.11	9.0	N. 88 W.	4.1	3.7	....	....	124.1
December, 1864	9	29.253	29.150	23.3	21.4	.103	.712	0.28	9.2	N. 87 W.	4.7	8.4	....	....	145.5
January, 1865	9	29.358	29.286	17.8	15.8	.072	.671	0.04	9.0	N. 60 W.	3.5	53.9	....	....	94.5
February, 1865	9	29.463	29.373	22.5	20.3	.090	.696	0.08	9.1	N. 2 E.	2.6	72.2	....	1.9	....
March, 1865	9	29.309	29.177	29.8	27.6	.132	.732	0.08	7.9	N. 58 W.	2.2	36.7	....	....	58.4
April, 1865	9	29.363	29.188	38.9	35.8	.175	.722	0.05	7.9	N. 86 W.	2.2	4.2	....	....	66.6
May, 1865	9	29.366	29.128	48.7	44.2	.238	.685	0.11	4.8	N. 71 E.	1.1	15.2	....	44.5	....
June, 1865	9	29.385	28.990	59.5	55.5	.395	.766	....	6.9	S. 9 E.	1.7	....	52.3	8.8	....
July, 1865	9	29.414	28.982	64.4	59.1	.433	.717	....	6.6	N. 37 W.	1.4	34.6	....	....	25.1
August, 1865	9	29.470	29.011	65.6	60.3	.459	.721	....	5.0	N. 3 W.	1.2	36.7	....	....	1.8
September, 1865	9	29.459	28.952	64.9	61.5	.507	.816	0.35	5.7	S. 8 W.	1.9	....	56.4	....	7.8
October, 1865	9	29.407	29.159	45.7	42.7	.248	.756	0.11	7.9	N. 1 E.	3.1	97.4	....	2.1	....
November, 1865	9	29.426	29.248	39.1	36.0	.178	.703	....	8.7	N. 80 W.	3.8	18.4	....	....	107.3
December, 1865	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Mean of spring	9	29.328	29.147	38.3	35.3	.181	.730	0.41	7.1	N. 17 E.	1.4	244.0	....	64.9	....
Mean of summer	9	29.416	28.958	65.1	60.0	.458	.723	0.02	5.5	N. 26 W.	0.9	152.8	....	....	79.8
Mean of autumn	9	29.379	29.097	47.7	44.9	.282	.769	0.79	7.8	N. 60 W.	1.4	131.0	....	....	213.9
Mean of winter	9	29.342	29.246	22.3	20.4	.096	.711	0.90	8.7	N. 71 W.	1.9	104.0	....	....	319.1
Means of all	9	29.366	29.112	43.3	40.1	.254	.733	2.12	7.3	N. 38 W.	1.1	631.8	....	....	547.9

Meteorological observations at Thunder Bay Island, &c.—Continued.

Date.	Time of observation.	Pressure reduced to 32° Fahr.		Temp., Fahr.		Vapor.		Am't of rain and melted snow, U. S. inches and decimals.	Am't cloudiness. (10=sky entirely overcast, 0=clear sky.)	Wind.					
		Total, U. S. inches and decimals.	Gaseous, U. S. inches and decimals.	Dry bulb.	Wet bulb.	Elasticity, U. S. inches and decimals.	Humidity. Saturation=1.000.			Observed direction; from whence.	Observed velocity; miles per hour.	Resolution of direction and velocity, in miles per hour.			
												N.	S.	E.	W.
	A. M.			°	°					°					
December, 1863	8.30	29.462	29.348	26.5	24.4	.114	.755	....	8.6	N. 85 E.	3.0	8.3	....	92.9	......
January, 1864	8.30	29.308	29.214	20.6	18.9	.094	.740	....	7.5	S. 82 W.	2.8	.....	12.6	.....	67.
February, 1864	8.30	29.197	29.093	22.5	20.7	.104	.715	....	8.6	N. 80 W.	2.5	12.9	....	.....	74.
March, 1864	8.30	29.271	29.161	25.6	23.5	.111	.731	....	7.3	N. 50 E.	2.4	47.2	....	55.9	......
April, 1864	8.30	29.370	29.192	38.0	35.5	.178	.780	....	7.9	N. 53 E.	3.4	62.2	....	82.1	......
May, 1864	8.30	29.286	29.035	47.1	43.8	.251	.766	....	7.7	N. 1 E.	3.4	104.0	....	2.3	......
June, 1864	8.30	29.457	29.069	61.2	55.7	.388	.683	....	4.1	N. 23 W.	1.5	40.9	....	.....	17.
July, 1864	8.30	29.428	28.908	67.7	63.0	.520	.760	....	5.0	N. 28 W.	0.7	18.9	....	.....	10.
August, 1864	8.30	29.345	28.798	69.8	64.5	.546	.739	....	6.0	N. 33 W.	2.7	72.5	....	.....	47.
September, 1864	8.30	29.363	29.003	56.2	52.9	.360	.771	....	7.7	N. 82 E.	2.1	8.4	....	63.0	......
October, 1864	8.30	29.314	29.079	43.5	41.3	.235	.814	....	8.4	N. 37 W.	2.8	68.4	....	.....	51.
November, 1864	8.30	29.308	29.147	34.5	32.3	.161	.775	....	9.1	N. 88 W.	4.4	4.6	....	.....	131.
December, 1864	8.30	29.252	29.148	23.1	21.3	.104	.722	....	9.3	N. 80 W.	5.2	28.8	....	.....	157.
January, 1865	8.30	29.356	29.284	17.5	15.5	.072	.670	....	8.8	N. 61 W.	3.7	55.5	....	.....	100.
February, 1865	8.30	29.460	29.372	21.7	19.7	.088	.702	....	9.0	N. 5 E.	3.0	82.8	....	7.4	......
March, 1865	8.30	29.309	29.179	29.2	27.1	.130	.736	....	8.0	N. 41 W.	1.8	43.1	....	.....	37.
April, 1865	8.30	29.362	29.192	37.9	35.0	.170	.728	....	8.0	N. 87 W.	2.3	4.0	....	.....	68.
May, 1865	8.30	29.364	29.126	48.2	44.0	.238	.698	....	5.0	N. 74 E.	1.7	14.2	....	50.0	......
June, 1865	8.30	29.385	28.992	58.9	55.2	.393	.779	....	6.6	S. 6 W.	1.7	.....	50.5	.....	5.
July, 1865	8.30	29.417	28.991	63.5	58.4	.426	.723	....	6.4	N. 38 W.	1.4	34.5	....	.....	25.
August, 1865	8.30	29.467	29.010	64.8	59.9	.457	.740	....	5.4	N. 17 W.	1.7	50.6	....	.....	14.
September, 1865	8.30	29.458	28.957	64.0	60.9	.501	.826	....	5.5	S. 6 W.	2.0	.....	58.9	.....	6.
October, 1865	8.30	29.406	29.165	45.2	42.2	.242	.763	....	7.8	N. 1 E.	3.0	94.3	....	1.1	......
November, 1865	8.30	29.424	29.246	38.6	35.7	.177	.753	....	8.9	N. 88 W.	3.4	4.2	....	.....	110.
December, 1865	....	......	......	....	....	....	....	....	....	....	....	.....	....	.....	......
Mean of spring	8.30	29.327	29.147	37.7	34.8	.180	.740	....	7.3	N. 15 E.	1.6	274.7	....	83.9	......
Mean of summer	8.30	29.416	28.961	64.3	59.4	.455	.737	....	5.6	N. 38 W.	1.2	166.9	....	.....	130.
Mean of autumn	8.30	29.379	29.099	47.0	44.2	.279	.784	....	7.9	N. 62 W.	1.5	121.0	....	.....	234.
Mean of winter	8.30	29.339	29.243	22.0	20.1	.096	.717	....	8.6	N. 60 W.	2.0	174.9	....	.....	315.
Means of all	8.30	29.365	29.112	42.7	39.6	.252	.744	....	7.3	N. 38 W.	1.3	737.5	....	.....	576.
December, 1863	8	29.458	29.345	26.3	24.3	.113	.753	0.29	8.5	N. 86 E.	3.3	7.9	....	101.8	......
January, 1864	8	29.301	29.211	20.3	18.7	.090	.746	0.06	7.5	N. 88 W.	2.8	3.2	....	.....	85.
February, 1864	8	29.192	29.085	22.2	20.5	.107	.719	0.20	8.4	N. 84 W.	2.6	8.3	....	.....	75.
March, 1864	8	29.268	29.160	24.9	22.9	.108	.724	0.20	7.4	N. 50 E.	2.2	43.7	....	51.6	......
April, 1864	8	29.367	29.191	37.3	35.1	.176	.789	0.03	8.1	N. 50 E.	3.2	61.7	....	73.9	......
May, 1864	8	29.284	29.039	46.3	43.1	.245	.772	0.07	7.7	North	3.2	97.9	....	0.7	......
June, 1864	8	29.457	29.071	60.3	55.2	.386	.704	....	4.3	N. 24 W.	2.1	57.1	....	.....	25.
July, 1864	8	29.428	28.914	66.6	62.8	.514	.777	0.03	4.7	N. 20 W.	1.2	34.9	....	.....	12.
August, 1864	8	29.342	28.800	68.8	64.0	.542	.758	0.01	6.3	N. 37 W.	2.6	65.3	....	.....	48.
September, 1864	8	29.359	28.998	56.0	52.6	.361	.788	0.07	7.7	N. 63 E.	2.5	33.6	....	66.2	......
October, 1864	8	29.309	29.077	42.9	40.8	.232	.825	0.06	8.0	N. 44 W.	2.5	57.5	....	.....	54.
November, 1864	8	29.305	29.146	34.3	32.1	.159	.773	0.07	9.0	S. 85 W.	4.4	.....	10.7	.....	132.
December, 1864	8	29.251	29.148	23.0	21.2	.103	.720	0.32	9.4	N. 81 W.	5.3	24.1	....	.....	161.
January, 1865	8	29.354	29.283	17.2	15.3	.071	.674	0.02	8.8	N. 57 W.	3.5	50.8	....	.....	90.
February, 1865	8	29.457	29.370	21.1	19.2	.087	.708	0.04	8.8	N. 8 E.	3.1	87.0	....	12.0	......
March, 1865	8	29.307	29.181	28.2	26.2	.126	.740	0.15	8.0	N. 28 W.	1.9	50.8	....	.....	26.
April, 1865	8	29.361	29.192	37.1	34.4	.168	.739	0.07	8.0	N. 89 W.	2.5	1.0	....	.....	71.
May, 1865	8	29.361	29.125	47.5	43.5	.236	.707	....	5.2	N. 53 E.	1.1	20.3	....	27.2	......
June, 1865	8	29.384	28.994	58.1	54.7	.390	.794	....	6.8	S. 4 W.	1.6	.....	48.0	.....	3.
July, 1865	8	29.416	29.001	62.5	57.6	.415	.732	....	5.9	N. 40 W.	1.2	27.9	....	.....	23.
August, 1865	8	29.465	29.013	63.7	59.3	.452	.759	0.17	5.4	N. 21 W.	1.4	40.0	....	.....	15.
September, 1865	8	29.457	28.964	63.1	60.3	.493	.840	0.32	5.8	S. 9 W.	1.8	....	53.2	.....	8.
October, 1865	8	29.406	29.168	44.6	41.8	.238	.773	0.04	7.8	N. 2 E.	2.8	85.2	....	2.1	......
November, 1865	8	29.422	29.246	38.2	35.5	.176	.742	....	8.7	S. 85 W.	3.7	.....	9.7	.....	165.
December, 1865	....	......	......	....	....	....	....	....	....	....	....	.....	....	.....	......
Mean of spring	8	29.325	29.148	36.9	34.2	.176	.745	0.52	7.4	N. 11 E.	1.5	275.4	....	52.4	......
Mean of summer	8	29.415	28.965	63.3	58.9	.449	.754	0.21	5.6	N. 35 W.	1.2	177.2	....	.....	128.
Mean of autumn	8	29.376	29.100	46.5	43.8	.276	.790	0.56	7.8	N. 65 W.	1.4	102.7	....	.....	233.
Mean of winter	8	29.335	29.240	21.7	19.9	.095	.720	0.93	8.6	N. 60 W.	2.0	181.3	....	.....	308.
Means of	8	29.363	29.113	42.1	39.2	.249	.752	2.22	7.3	N. 38 W.	1.3	736.6	....	.....	618.

Meteorological observations at Thunder Bay Island, &c.—Continued.

Date.	Time of observation.	Pressure reduced to 32° Fahr.		Temp., Fahr.		Vapor.		Am't of rain and melted snow, U. S. inches and decimals.	Am't cloudiness. (10=sky entirely overcast, 0=clear sky.)	Wind.					
		Total, U. S. inches and decimals.	Gaseous, U. S. inches and decimals.	Dry bulb.	Wet bulb.	Elasticity, U. S. inches and decimals.	Humidity. Saturation = 1.000.			Observed direction; from whence.	Observed velocity; miles per hour.	Resolution of direction and velocity, in miles per hour.			
												N.	S.	E.	W.
	A.M.			°	°					°					
December, 1863	7.30	29.449	29.335	26.3	24.4	.114	.741	....	8.3	N. 86 E.	3.5	7.8	....	108.6	.....
January, 1864	7.30	29.298	29.205	20.0	18.5	.093	.745	....	7.7	S. 87 W.	3.0	......	4.3	.....	92.8
February, 1864	7.30	29.186	29.081	22.0	20.3	.105	.724	....	8.4	N. 88 W.	3.7	2.8	....	.....	78.0
March, 1864	7.30	29.262	29.156	24.0	23.1	.105	.732	....	7.3	N. 42 E.	1.9	44.2	....	39.5	.....
April, 1864	7.30	29.370	29.196	36.5	34.4	.173	.802	....	8.1	N. 53 E.	3.1	56.1	....	74.4	.....
May, 1864	7.30	29.284	29.039	45.6	42.8	.245	.788	....	7.7	N. 6 W.	3.3	102.8	....	.....	10.9
June, 1864	7.30	29.453	29.076	59.1	54.3	.377	.709	....	4.4	N. 25 W.	2.3	64.5	....	.....	29.3
July, 1864	7.39	29.425	28.926	65.6	61.7	.500	.794	....	5.2	N. 23 W.	1.1	31.3	....	.....	13.1
August, 1864	7.30	29.340	28.809	67.6	63.2	.531	.773	....	6.3	N. 34 W.	2.5	63.7	....	.....	42.6
September, 1864	7.30	29.359	29.002	55.2	52.1	.356	.837	....	7.6	N. 75 E.	2.7	21.4	....	77.4	....
October, 1864	7.30	29.306	29.076	42.4	40.4	.230	.832	....	8.1	N. 48 W.	2.6	53.8	....	.....	60.1
November, 1864	7.30	29.302	29.142	34.2	32.0	.160	.779	....	9.1	S. 85 W.	4.5	......	10.7	.....	135.9
December, 1864	7.30	29.252	29.149	22.8	21.0	.103	.732	....	9.4	N. 67 W.	5.7	68.1	....	.....	164.4
January, 1865	7.30	29.353	29.283	16.8	14.9	.070	.669	....	8.7	N. 61 W.	3.7	56.4	....	.....	101.1
February, 1865	7.30	29.456	29.369	20.8	18.9	.087	.711	....	8.7	N. 12 E.	3.0	83.6	....	18.0	.....
March, 1865	7.30	29.306	29.184	27.1	25.4	.122	.738	....	8.2	N. 12 W.	1.7	52.4	....	.....	11.7
April, 1865	7.30	29.357	29.192	36.1	33.5	.164	.748	....	7.6	N. 79 W.	2.5	13.8	....	.....	72.8
May, 1865	7.30	29.361	29.129	46.5	42.7	.232	.720	....	5.4	N. 36 E.	1.1	26.2	....	19.1	.....
June, 1865	7.30	29.382	29.001	57.1	54.0	.381	.804	....	6.9	S. 2 W.	1.5	......	46.2	.....	1.5
July, 1865	7.30	29.414	29.009	61.2	56.8	.405	.744	....	5.9	N. 51 W.	1.6	31.2	....	.....	38.3
August, 1865	7.30	29.464	29.023	62.4	58.4	.441	.773	....	5.5	N. 34 W.	1.2	36.6	....	.....	22.3
September, 1865	7.30	29.457	28.975	62.0	59.5	.482	.857	....	5.8	S. 17 W.	1.9	......	54.1	.....	16.9
October, 1865	7.30	29.404	29.167	44.1	41.4	.237	.781	....	7.8	N. 7 E.	2.5	75.5	....	9.2	.....
November, 1865	7.30	29.421	29.243	37.9	35.4	.178	.758	....	8.6	N. 89 W.	3.8	2.2	....	.....	109.5
December, 1865	....	......	......	....	....	....	....	....	....	....	....	......	....	.....	.....
Mean of spring	7.30	29.323	29.148	36.0	33.5	.173	.755	....	7.7	N. 7 E.	1.6	295.5	....	37.6	.....
Mean of summer	7.30	29.413	28.974	62.2	58.1	.439	.766	....	5.7	N. 38 W.	1.3	177.[illegible]	....	.....	147.1
Mean of autumn	7.30	29.375	29.101	46.0	43.5	.274	.807	....	7.8	N. 70 W.	1.5	88.1	....	.....	245.8
Mean of winter	7.30	29.332	29.237	21.4	19.7	.095	.720	....	8.5	N. 54 W.	2.1	214.4	....	.....	309.7
Means of all	7.30	29.360	29.115	4[illegible].4	38.7	.245	.762	....	7.4	N. 39 W.	1.5	775.1	....	.....	665.0
December, 1863	7	29.447	29.334	26.3	24.3	.113	.746	0.26	8.4	N. 80 E.	2.7	15.3	....	83.0	.....
January, 1864	7	29.294	29.202	19.9	18.3	.092	.731	0.07	7.4	N. 85 W.	2.9	8.9	....	.....	90.6
February, 1864	7	29.183	29.078	21.9	20.2	.104	.723	0.16	8.8	N. 88 W.	2.7	2.3	....	.....	80.5
March, 1864	7	29.252	29.149	23.4	21.5	.103	.733	0.16	7.1	N. 39 E.	2.4	57.6	....	46.7	.....
April, 1864	7	29.363	29.192	35.7	33.8	.171	.815	0.20	7.9	N. 55 E.	3.2	55.0	....	79.9	.....
May, 1864	7	29.281	29.039	44.9	42.3	.242	.800	0.12	7.6	N. 6 W.	3.6	112.0	....	.....	12.6
June, 1864	7	29.452	29.078	57.7	53.5	.374	.743	....	4.1	N. 24 W.	2.4	64.9	....	.....	29.3
July, 1864	7	29.425	28.926	65.6	61.7	.500	.794	0.02	5.2	N. 23 W.	1.1	31.3	....	.....	13.1
August, 1864	7	29.336	28.820	66.2	62.2	.516	.784	0.01	6.3	N. 35 W.	2.4	60.7	....	.....	44.0
September, 1864	7	29.358	29.005	54.5	51.6	.353	.811	0.03	7.6	N. 65 E.	2.4	30.5	....	66.[illegible]	.....
October, 1864	7	29.303	29.073	42.1	40.2	.230	.839	0.26	8.0	N. 49 W.	2.1	56.4	....	.....	65.1
November, 1864	7	29.300	29.140	34.1	32.0	.160	.780	0.16	9.2	S. 89 W.	4.7	......	1.7	.....	140.2
December, 1864	7	29.250	29.148	22.5	20.8	.102	.733	0.37	9.4	N. 79 W.	5.1	30.4	....	.....	156.8
January, 1865	7	29.354	29.284	16.7	14.8	.070	.672	0.02	8.6	N. 58 W.	4.0	65.6	....	.....	106.2
February, 1865	7	29.451	29.365	20.5	18.6	.086	.711	0.06	8.5	N. 11 E.	2.3	64.2	....	12.2	.....
March, 1865	7	29.304	29.184	26.7	24.7	.120	.739	0.18	8.0	N. 20 W.	2.0	57.0	....	.....	21.7
April, 1865	7	29.352	29.192	35.2	32.8	.160	.755	0.18	7.5	N. 85 W.	2.7	7.0	....	.....	81.8
May, 1865	7	29.361	29.134	45.2	41.8	.227	.739	....	5.6	N. 17 E.	1.1	32.4	....	9.9	.....
June, 1865	7	29.379	29.002	56.2	53.4	.377	.821	0.02	6.8	S. 18 W.	1.4	......	39.2	.....	13.2
July, 1865	7	29.411	29.015	59.9	55.9	.396	.762	0.09	6.0	N. 44 W.	1.6	36.1	....	.....	33.9
August, 1865	7	29.466	29.030	61.2	57.6	.434	.788	0.29	5.4	N. 75 W.	0.4	3.6	....	.....	12.3
September, 1865	7	29.456	28.985	61.1	58.8	.471	.860	0.21	5.9	S. 19 W.	2.0	......	55.9	.....	19.4
October, 1865	7	29.402	29.166	43.7	41.2	.235	.788	0.13	7.8	N. 9 E.	2.6	78.1	....	12.0	.....
November, 1865	7	29.417	29.240	37.9	35.3	.178	.759	0.02	8.3	N. 85 W.	3.9	10.4	....	.....	113.3
December, 1865	....	......	......	....	....	....	....	....	....	....	....	......	....	.....	.....
Mean of spring	7	29.319	29.148	35.2	32.8	.170	.763	0.84	7.3	N. 3 E.	1.7	321.0	....	20.4	.....
Mean of summer	7	29.411	28.978	61.1	57.4	.433	.782	0.43	5.6	N. 42 W.	1.2	157.4	....	.....	145.8
Mean of autumn	7	29.373	29.101	45.6	43.2	.271	.806	0.81	7.8	N. 67 W.	1.5	117.8	....	.....	259.3
Mean of winter	7	29.330	29.235	21.3	19.5	.094	.719	0.94	8.3	N. 62 W.	2.2	186.7	....	.....	338.9
Means of all	7	29.358	29.115	40.8	38.2	.242	.767	3.02	7.2	N. 42 W.	1.5	782.9	....	.....	723.6

Meteorological observations at Thunder Bay Island, &c.—**Continued.**

Date.	Time of observation.	Pressure reduced to 32° Fahr.		Temp., Fahr.		Vapor.		Am't of rain and melted snow, U. S. inches and decimals.	Am't cloudiness. (10=sky entirely overcast, 0=clear sky.)	Wind.					
		Total, U. S. inches and decimals.	Gaseous, U. S. inches and decimals.	Dry bulb.	Wet bulb.	Elasticity, U. S. inches and decimals.	Humidity. Saturation = 1.000.			Observed direction; from whence.	Observed velocity; miles per hour.	Resolution of direction and velocity, in miles per hour.			
												N.	S.	E.	W.
	A.M.			°	°					°					
December, 1863	6.30	29.443	29.329	26.2	24.3	.114	.775	....	8.5	N. 63 E.	2.2	30.2	....	59.2	......
January, 1864	6.30	29.291	29.200	19.9	18.3	.091	.726	....	7.4	N. 74 W.	3.3	28.1	....	....	98.7
February, 1864	6.30	29.178	29.075	21.8	20.1	.103	.714	....	8.7	N. 82 W.	2.8	11.0	....	....	81.7
March, 1864	6.30	29.252	29.148	23.2	21.4	.103	.740	....	7.1	N. 64 E.	2.5	34.7	....	71.3	......
April, 1864	6.30	29.359	29.191	34.8	33.0	.167	.824	....	7.9	N. 52 E.	3.0	55.3	....	71.0	......
May, 1864	6.30	29.278	29.041	43.9	41.5	.237	.812	....	7.8	N. 8 W.	3.8	116.2	....	....	15.1
June, 1864	6.30	29.452	29.083	56.5	52.9	.369	.761	....	3.9	N. 32 W.	1.9	48.1	....	....	31.3
July, 1864	6.30	29.424	28.939	63.3	60.2	.485	.824	....	5.3	N. 17 W.	1.0	44.3	....	....	14.3
August, 1864	6.30	29.334	28.824	65.4	61.7	.510	.800	....	6.4	N. 37 W.	2.5	60.6	....	....	45.6
September, 1864	6.30	29.358	29.010	53.9	51.2	.348	.844	....	7.3	N. 61 E.	2.5	36.2	....	64.6	......
October, 1864	6.30	29.301	29.073	41.9	40.0	.228	.839	....	7.9	N. 53 W.	2.5	46.3	....	....	62.9
November, 1864	6.30	29.298	29.137	34.1	32.0	.161	.778	....	9.2	S. 89 W.	4.8	......	2.0	....	144.9
December, 1864	6.30	29.249	29.147	22.4	20.6	.102	.731	....	9.4	N. 78 W.	5.4	34.6	....	....	164.4
January, 1865	6.30	29.356	29.286	16.6	14.8	.070	.680	....	8.7	N. 55 W.	4.3	74.8	....	....	108.1
February, 1865	6.30	29.452	29.367	20.2	18.4	.085	.714	....	8.3	N. 3 W.	2.7	74.8	....	....	3.5
March, 1865	6.30	29.303	29.185	26.0	24.1	.118	.741	....	7.8	N. 17 W.	2.5	72.2	....	....	22.5
April, 1865	6.30	29.351	29.195	34.2	31.9	.156	.763	....	7.4	N. 81 W.	3.1	14.0	....	....	91.6
May, 1865	6.30	29.355	29.132	43.9	40.9	.223	.762	....	5.6	N. 9 E.	1.0	30.9	....	4.9	......
June, 1865	6.30	29.376	29.007	55.3	52.7	.369	.832	....	6.8	S. 11 W.	1.4	......	43.9	....	8.3
July, 1865	6.30	29.406	29.016	58.8	55.1	.390	.781	....	6.0	N. 43 W.	1.9	41.4	....	....	38.6
August, 1865	6.30	29.462	29.040	60.0	56.7	.422	.802	....	5.5	N. 40 W.	0.8	19.8	....	....	16.1
September, 1865	6.30	29.455	28.991	60.6	58.3	.464	.862	....	6.2	S. 24 W.	2.0	......	54.7	....	24.3
October, 1865	6.30	29.403	29.170	43.4	40.9	.233	.790	....	7.8	N. 19 E.	2.6	81.8	....	12.7	......
November, 1865	6.30	29.419	29.241	37.8	35.2	.178	.762	....	8.3	N. 88 W.	4.0	3.9	....	....	115.1
December, 1865	....	......	......	....	....	....	....	....	....	......	....	......	....	....	......
Mean of spring	6.30	29.316	29.149	34.2	32.1	.168	.774	....	7.3	N. 3 E.	1.8	323.3	....	18.0	......
Mean of summer	6.30	29.409	28.984	59.9	56.5	.424	.800	....	5.6	N. 38 W.	1.3	170.3	....	....	154.2
Mean of autumn	6.30	29.372	29.104	45.3	42.9	.269	.812	....	7.8	N. 67 W.	1.5	111.5	....	....	259.9
Mean of winter	6.30	29.328	29.234	21.2	19.4	.094	.723	....	8.5	N. 57 W.	2.6	253.5	....	....	397.2
Means of all	6.30	29.356	29.118	40.1	37.7	.239	.777	....	7.3	N. 42 W.	1.6	858.6	....	....	793.3
	A.M.														
December, 1863	6	29.445	29.330	26.3	24.3	.115	.758	0.34	8.5	N. 58 E.	1.8	29.6	....	46.7	......
January, 1864	6	29.283	29.190	19.8	18.2	.093	.732	0.04	7.3	N. 75 W.	3.6	28.3	....	....	109.9
February, 1864	6	29.176	29.072	21.7	20.1	.104	.723	0.29	8.6	N. 77 W.	2.5	16.3	....	....	72.7
March, 1864	6	29.245	29.142	22.9	21.2	.103	.741	0.14	7.1	N. 62 E.	2.3	33.4	....	63.0	......
April, 1864	6	29.356	29.190	34.3	32.6	.166	.829	0.21	8.0	N. 51 E.	3.3	62.8	....	77.4	......
May, 1864	6	29.278	29.041	43.9	41.5	.237	.812	0.15	7.8	N. 8 W.	3.8	116.2	....	....	15.1
June, 1864	6	29.449	29.093	54.9	51.6	.356	.781	....	4.3	N. 32 W.	2.3	58.9	....	....	36.8
July, 1864	6	29.422	28.947	62.2	59.4	.474	.837	0.12	5.4	N. 25 W.	1.7	47.2	....	....	22.5
August, 1864	6	29.333	28.823	64.8	61.4	.510	.811	0.05	6.9	N. 34 W.	2.3	57.5	....	....	41.1
September, 1864	6	29.355	28.998	53.4	51.5	.357	.828	0.05	7.2	N. 52 E.	2.9	52.7	....	68.3	......
October, 1864	6	29.301	29.073	41.9	40.0	.228	.836	0.20	8.0	N. 48 W.	2.7	55.6	....	....	61.6
November, 1864	6	29.298	29.136	34.1	32.1	.162	.784	0.22	9.1	S. 89 W.	4.7	....	3.2	....	140.2
December, 1864	6	29.249	29.148	22.3	20.5	.101	.733	0.38	9.0	N. 76 W.	5.5	40.5	....	....	165.2
January, 1865	6	29.357	29.287	16.5	14.7	.070	.678	0.09	8.8	N. 53 W.	4.5	84.1	....	....	111.2
February, 1865	6	29.452	29.367	20.0	18.2	.085	.716	0.09	8.2	N. 2 W.	2.7	75.4	....	....	1.9
March, 1865	6	29.302	29.187	25.5	23.6	.115	.729	0.23	7.8	N. 18 W.	2.6	75.5	....	....	94.5
April, 1865	6	29.346	29.193	33.3	31.2	.153	.776	0.06	7.3	N. 83 W.	2.6	9.5	....	....	79.4
May, 1865	6	29.352	29.135	42.6	39.9	.217	.777	0.03	6.0	N. 23 E.	0.9	27.1	....	11.0	......
June, 1865	6	29.371	29.010	54.4	52.0	.361	.841	0.02	7.0	S. 11 W.	1.3	......	38.4	....	7.2
July, 1865	6	29.404	29.023	57.6	54.3	.380	.795	0.12	6.0	N. 49 W.	2.1	43.5	....	....	49.8
August, 1865	6	29.461	29.050	59.1	55.9	.411	.808	0.20	5.5	N. 36 W.	1.0	24.8	....	....	18.1
September, 1865	6	29.453	28.991	60.5	58.2	.462	.860	0.40	6.0	S. 31 W.	1.9	......	48.4	....	29.4
October, 1865	6	29.403	29.173	43.0	40.6	.230	.791	....	8.0	N. 70 E.	2.9	89.4	....	10.3	......
November, 1865	6	29.420	29.241	37.8	35.3	.179	.763	....	7.9	N. 86 W.	3.5	7.8	....	....	101.6
December, 1865	....	......	......	....	....	....	....	....	....	......	....	......	....	....	......
Mean of spring	6	29.313	29.148	33.7	31.7	.165	.778	0.82	7.3	N. 6 E.	1.8	324.5	....	32.4	......
Mean of summer	6	29.406	28.991	58.8	55.8	.415	.812	0.51	5.8	N. 42 W.	1.5	193.5	....	....	175.5
Mean of autumn	6	29.372	29.102	45.1	42.9	.269	.810	0.87	7.7	N. 60 W.	1.6	153.9	....	....	254.2
Mean of winter	6	29.327	29.232	21.1	19.3	.095	.723	1.23	8.4	N. 58 W.	2.7	274.2	....	....	414.2
Mean of all	6	29.354	29.118	39.7	37.4	.236	.781	3.43	7.3	N. 40 W.	1.7	946.1	....	....	811.5

Meteorological observations at Thunder Bay Island, &c.—Continued.

Date.	Time of observation.	Pressure reduced to 32° Fahr.		Temp., Fahr.		Vapor.		Am't of rain and melted snow, U. S. inches and decimals.	Am't cloudiness. (10=sky entirely overcast. 0=clear sky.)	Wind.					
		Total U. S. inches and decimals.	Gaseous, U. S. inches and decimals.	Dry bulb.	Wet bulb.	Elasticity, U. S. inches and decimals.	Humidity. Saturation = 1.000.			Observed direction; from whence.	Observed velocity; miles per hour.	Resolution of direction and velocity, in miles per hour.			
												N.	S.	E.	W.
	A. M.			°	°					°					
December, 1863	5. 30	29. 441	29. 325	26. 2	24. 2	. 116	. 747	....	8. 2	S. 88 E.	1. 1	......	1. 1	36. 5	......
January, 1864	5. 30	29. 287	29. 194	19. 8	18. 2	. 093	. 750	....	7. 3	N. 66 W.	3. 7	46. 3	....	....	105. 9
February, 1864	5. 30	29. 175	29. 071	21. 7	20. 1	. 104	. 719	....	8. 5	N. 72 W.	3. 0	27. 1	....	....	81. 5
March, 1864	5. 30	29. 244	29. 136	22. 8	21. 2	. 108	. 763	....	6. 8	N. 47 E.	2. 2	47. 4	....	50. 1	......
April, 1864	5. 30	29. 354	29. 193	33. 9	32. 1	. 161	. 820	....	8. 0	N. 50 E.	3. 2	61. 0	....	72. 2	......
May, 1864	5. 30	29. 274	29. 041	43. 1	40. 9	. 233	. 822	....	7. 6	N. 9 W.	3. 7	112. 7	....	....	17. 6
June, 1864	5. 30	29. 445	29. 101	53. 8	50. 6	. 344	. 782	....	3. 8	N. 30 W.	2. 7	69. 3	....	....	40. 8
July, 1864	5. 30	29. 420	28. 953	61. 6	58. 9	. 467	. 839	....	5. 4	N. 27 W.	2. 0	54. 8	....	....	27. 8
August, 1864	5. 30	29. 331	28. 828	64. 5	61. 0	. 503	. 811	....	6. 9	N. 38 W.	1. 9	46. 0	....	....	36. 2
September, 1864	5. 30	29. 355	29. 003	53. 2	51. 3	. 352	. 827	....	6. 9	N. 49 E.	2. 1	41. 9	....	47. 8	......
October, 1864	5. 30	29. 299	29. 071	41. 8	39. 9	. 228	. 836	....	7. 9	N. 46 W.	2. 7	57. 6	....	....	59. 4
November, 1864	5. 30	29. 298	29. 137	34. 1	32. 0	. 161	. 783	....	8. 9	S. 87 W.	4. 8	......	7. 7	....	143. 0
December, 1864	5. 30	29. 249	29. 148	22. 2	20. 5	. 101	. 737	....	8. 8	N. 67 W.	5. 4	63. 5	....	....	153. 9
January, 1865	5. 30	29. 358	29. 289	16. 3	14. 5	. 069	. 676	....	8. 7	N. 54 W.	4. 9	89. 8	....	....	123. 5
February, 1865	5. 30	29. 450	29. 365	19. 9	18. 1	. 085	. 719	....	8. 2	N. 5 W.	2. 7	75. 1	....	....	6. 5
March, 1865	5. 30	29. 303	29. 190	25. 2	23. 3	. 113	. 724	....	7. 9	N. 18 W.	2. 5	73. 0	....	....	24. 3
April, 1865	5. 30	29. 346	29. 195	32. 9	30. 8	. 151	. 779	....	7. 1	N. 78 W.	2. 5	15. 6	....	....	72. 2
May, 1865	5. 30	29. 350	29. 138	41. 6	39. 1	. 212	. 789	....	6. 0	N. 21 E.	1. 0	28. 4	....	11. 1	......
June, 1865	5. 30	29. 368	29. 013	53. 6	51. 4	. 355	. 849	....	7. 0	S. 15 W.	1. 2	......	35. 1	....	9. 7
July, 1865	5. 30	29. 400	29. 028	56. 6	53. 5	. 371	. 803	....	5. 9	N. 45 W.	2. 0	54. 3	....	....	53. 6
August, 1865	5. 30	29. 461	29. 055	58. 6	55. 5	. 406	. 809	....	5. 2	N. 38 W.	1. 1	27. 6	....	....	21. 6
September, 1865	5. 30	29. 451	28. 994	60. 5	58. 0	. 457	. 855	....	5. 8	S. 34 W.	1. 8	......	45. 5	....	30. 1
October, 1865	5. 30	29. 402	29. 172	43. 0	40. 5	. 230	. 793	....	7. 8	N. 9 E.	3. 0	92. 9	....	14. 7	......
November, 1865	5. 30	29. 421	29. 240	37. 8	35. 3	. 180	. 769	....	7. 6	West ...	3. 4	0. 2	....	....	99. 1
December, 1865	....	......	......	....	....	....	....	....	....	....	....	......	....	....	......
Mean of spring	5. 30	29. 312	29. 194	33. 2	31. 2	. 163	. 783	....	7. 2	N. 3 E.	1. 9	238. 1	....	19. 3	......
Mean of summer	5. 30	29. 404	28. 996	58. 1	55. 1	. 408	. 815	....	5. 7	N. 40 W.	1. 6	216. 9	....	....	189. 7
Mean of autumn	5. 30	29. 371	29. 103	45. 1	42. 8	. 268	. 810	....	7. 5	N. 87 W.	1. 7	139. 4	....	....	269. 1
Mean of winter	5. 30	29. 327	29. 232	21. 0	19. 3	. 095	. 725	....	8. 3	N. 55 W.	2. 9	300. 7	....	....	434. 8
Means of all	5. 30	29. 353	29. 120	39. 3	37. 1	. 233	. 783	....	7. 2	N. 41 W.	2. 1	995. 1	....	....	874. 3
December, 1863	5	29. 439	29. 327	26. 1	24. 0	. 112	. 739	0. 51	8. 2	N. 79 E.	1. 9	11. 9	....	58. 6	......
January, 1864	5	29. 284	29. 191	19. 8	18. 3	. 093	. 740	0. 13	7. 3	N. 73 W.	4. 2	36. 8	....	....	122. 8
February, 1864	5	29. 174	29. 070	21. 8	20. 2	. 104	. 734	0. 18	8. 2	N. 59 W.	3. 0	44. 2	....	....	73. 9
March, 1864	5	29. 247	29. 141	22. 8	21. 0	. 106	. 753	0. 15	6. 5	N. 37 E.	2. 4	60. 2	....	46. 2	......
April, 1864	5	29. 346	29. 185	33. 8	32. 0	. 161	. 823	0. 13	8. 0	N. 51 E.	3. 1	58. 4	....	71. 4	......
May, 1864	5	29. 268	29. 042	42. 3	40. 1	. 226	. 822	0. 07	7. 9	N. 9 W.	3. 9	121. 1	....	....	18. 4
June, 1864	5	29. 442	29. 102	53. 3	50. 1	. 340	. 785	....	3. 8	N. 22 W.	3. 1	84. 2	....	....	35. 8
July, 1864	5	39. 419	28. 954	61. 3	58. 7	. 465	. 846	0. 32	5. 3	N. 38 W.	2. 0	47. 9	....	....	36. 9
August, 1864	5	29. 329	28. 824	64. 3	61. 0	. 505	. 819	0. 05	6. 7	N. 41 W.	2. 3	53. 7	....	....	46. 1
September, 1864	5	29. 357	29. 012	53. 1	50. 6	. 344	. 832	0. 10	6. 8	N. 49 E.	2. 0	39. 6	....	45. 5	......
October, 1864	5	29. 299	29. 073	41. 7	39. 8	. 226	. 833	0. 09	7. 7	N. 52 W.	3. 8	53. 9	....	....	68. 3
November, 1864	5	29. 298	29. 138	34. 0	31. 9	. 160	. 781	0. 20	8. 7	S. 87 W.	5. 1	......	6. 5	....	152. 0
December, 1864	5	29. 251	29. 151	22. 1	20. 4	. 100	. 730	0. 25	8. 4	N. 65 W.	5. 3	67. 4	....	....	147. 2
January, 1865	5	29. 358	29. 290	16. 1	14. 2	. 068	. 675	0. 01	8. 8	N. 51 W.	4. 6	89. 2	....	....	110. 9
February, 1865	5	29. 451	29. 367	19. 6	17. 8	. 084	. 713	0. 16	8. 2	N. 4 W.	2. 5	70. 2	....	....	5. 6
March, 1865	5	29. 305	29. 192	25. 1	23. 2	. 113	. 723	0. 19	8. 2	N. 14 W.	2. 3	68. 7	....	....	17. 6
April, 1865	5	29. 348	29. 199	32. 5	30. 5	. 149	. 780	0. 22	6. 9	N. 82 W.	2. 3	9. 2	....	....	67. 4
May, 1865	5	29. 348	29. 140	40. 9	38. 5	. 208	. 794	....	5. 6	N. 26 E.	1. 2	34. 5	....	16. 7	......
June, 1865	5	29. 366	29. 016	53. 1	50. 9	. 350	. 854	....	7. 3	S. 8 W.	1. 1	......	34. 3	....	4. 8
July, 1865	5	29. 399	29. 034	55. 9	52. 9	. 365	. 808	0. 12	5. 5	N. 45 W.	2. 6	56. 5	....	....	57. 6
August, 1865	5	29. 463	29. 055	58. 5	55. 5	. 408	. 815	0. 25	4. 7	N. 38 W.	1. 0	24. 6	....	....	19. 3
September, 1865	5	29. 450	28. 994	60. 5	58. 1	. 456	. 850	0. 36	5. 7	S. 33 W.	1. 4	......	36. 5	....	23. 6
October, 1855	5	29. 400	29. 171	42. 9	40. 5	. 229	. 791	0. 10	7. 7	N. 10 E.	3. 1	94. 5	....	16. 1	......
November, 1865	5	29. 419	29. 239	37. 8	35. 3	. 180	. 767	....	7. 2	S. 88 W.	3. 5	......	4. 0	....	100. 6
December, 1865	....	......	......	....	....	....	....	....	....	....	....	......	....	....	......
Mean of spring	5	29. 310	29. 150	32. 9	30. 9	. 160	. 782	0. 76	7. 2	N. 6 E.	1. 9	352. 1	....	30. 9	......
Mean of summer	5	29. 403	28. 997	57. 7	54. 8	. 405	. 821	0. 74	5. 5	N. 40 W.	1. 7	232. 6	....	....	200. 6
Mean of autumn	5	29. 370	29. 104	45. 0	42. 7	. 249	. 809	0. 85	7. 3	N. 87 W.	1. 8	141. 0	....	....	282. 9
Mean of winter	5	29. 326	29. 233	20. 9	19. 1	. 093	. 722	1. 24	8. 2	N. 51 W.	2. 8	319. 7	....	....	401. 8
Means of all	5	29. 352	29. 121	39. 1	36. 9	. 227	. 783	3. 59	7. 0	N. 41 W.	1. 9	1045. 4	....	....	854. 4

Meteorological observations at Thunder Bay Island, &c.—**Continued.**

Date.	Time of observation.	Pressure reduced to 32° Fahr.		Temp., Fahr.		Vapor.		Am't of rain and melted snow, U. S. inches and decimals.	Am't cloudiness. (10=sky entirely overcast, 0=clear sky.)	Wind.					
		Total, U. S. inches and decimals.	Gaseous, U. S. inches and decimals.	Dry bulb.	Wet bulb.	Elasticity, U. S. inches and decimals.	Humidity, Saturation = 1.000.			Observed direction; from whence.	Observed velocity; miles per hour.	Resolution of directi and velocity, in mi per hour.			
												N.	S.	E.	W.
	A. M.			°	°					°					
December, 1863	4. 30	29. 435	29. 322	25. 9	24. 0	. 113	. 759	....	8. 6	N. 60 E.	1. 3	24. 2	....	42. 1	....
January, 1864	4. 30	29. 282	29. 191	19. 9	18. 3	. 091	. 731	....	7. 4	N. 60 W.	4. 6	73. 0	....	....	134.
February, 1864	4. 30	29. 175	29. 071	21. 8	20. 2	. 104	. 723	....	8. 1	N. 63 W.	3. 3	43. 3	....	....	86.
March, 1864	4. 30	29. 249	29. 146	22. 8	21. 0	. 103	. 746	....	6. 5	N. 29 E.	2. 8	74. 9	....	41. 7	....
April, 1864	4. 30	29. 345	29. 184	33. 7	32. 0	. 161	. 823	....	7. 9	N. 54 E.	2. 6	45. 7	....	63. 2	....
May, 1864	4. 30	29. 268	29. 042	42. 3	40. 2	. 226	. 821	....	8. 1	N. 7 W.	4. 1	131. 9	....	....	15.
June, 1864	4. 30	29. 428	29. 088	53. 1	50. 1	. 340	. 789	....	3. 9	N. 16 W.	3. 1	89. 3	....	....	25.
July, 1864	4. 30	29. 418	28. 958	61. 1	58. 5	. 460	. 843	....	5. 2	N. 41 W.	2. 3	54. 0	....	....	46.
August, 1864	4. 30	29. 329	28. 824	64. 3	61. 0	. 505	. 817	....	6. 6	N. 34 W.	2. 5	64. 9	....	....	42.
September, 1864	4. 30	29. 360	29. 017	53. 0	50. 5	. 343	. 829	....	6. 5	N. 55 E.	2. 0	34. 6	....	48. 3	....
October, 1864	4. 30	29. 297	29. 071	41. 8	39. 8	. 226	. 829	....	7. 9	N. 52 W.	3. 0	56. 7	....	....	73.
November, 1864	4. 30	29. 297	29. 137	34. 0	31. 9	. 160	. 780	....	8. 7	S. 66 W.	5. 2	......	9. 5	....	155.
December, 1864	4. 30	29. 251	29. 151	22. 0	20. 3	. 100	. 726	....	8. 3	N. 64 W.	5. 3	73. 9	....	....	142.
January, 1865	4. 30	29. 359	29. 292	15. 9	14. 1	. 067	. 669	....	8. 7	N. 48 W.	4. 6	93. 4	....	....	105.
February, 1865	4. 30	29. 452	29. 370	19. 2	17. 4	. 082	. 705	....	8. 1	N. 9 W.	2. 5	68. 8	....	....	10.
March, 1865	4. 30	29. 306	29. 194	24. 9	23. 0	. 112	. 721	....	8. 1	N. 17 W.	2. 6	77. 9	....	....	24.
April, 1865	4. 30	29. 352	29. 204	32. 3	30. 2	. 148	. 779	....	6. 9	N. 72 W.	2. 0	18. 5	....	....	52.
May, 1865	4. 30	29. 349	29. 143	40. 5	38. 2	. 206	. 795	....	5. 5	N. 21 E.	1. 2	34. 1	....	14. 1	....
June, 1865	4. 30	29. 365	29. 020	52. 6	50. 5	. 345	. 852	....	7. 4	S. 8 W.	1. 1	......	34. 1	....	4.
July, 1865	4. 30	29. 400	29. 032	55. 6	52. 6	. 368	. 812	....	5. 4	N. 47 W.	2. 7	57. 0	....	....	61.
August, 1865	4. 30	29. 464	29. 057	58. 5	55. 5	. 407	. 816	....	4. 1	N. 38 W.	1. 1	25. 9	....	....	19.
September, 1865	4. 30	29. 448	28. 991	60. 6	58. 1	. 457	. 849	....	5. 7	S. 33 W.	1. 2	......	29. 8	....	19.
October, 1865	4. 30	29. 399	29. 172	42. 8	40. 3	. 227	. 788	....	7. 6	N. 11 E.	3. 6	109. 2	....	21. 9	....
November, 1865	4. 30	29. 421	29. 241	37. 9	35. 4	. 180	. 763	....	7. 1	N. 88 W.	3. 8	3. 1	....	....	111.
December, 1865	....	......	......	....	....	....	....	....	....	....	....	......	....	....	....
Mean of spring	4. 30	29. 311	29. 152	32. 7	30. 8	. 159	. 781	....	7. 2	N. 3 E.	2. 1	383. 0	....	90. 5	....
Mean of summer	4. 30	29. 401	28. 997	57. 5	54. 7	. 404	. 821	....	5. 4	N. 43 W.	1. 9	257. 0	....	....	229.
Mean of autumn	4. 30	29. 370	29. 105	45. 0	42. 7	. 266	. 806	....	7. 2	N. 87 W.	1. 8	154. 3	....	....	286.
Mean of winter	4. 30	29. 326	29. 233	20. 8	19. 0	. 093	. 718	....	8. 2	N. 49 W.	3. 2	376. 6	....	....	422.
Means of all	4. 30	29. 352	29. 121	39. 0	36. 8	. 230	. 781	....	7. 0	N. 39 W.	2. 1	1170. 9	....	....	943.
	A. M.														
December, 1863	4	29. 438	29. 325	26. 0	24. 0	. 113	. 743	0. 29	8. 2	N. 61 E.	1. 0	14. 5	....	26. 7	....
January, 1864	4	29. 278	29. 186	19. 9	18. 3	. 092	. 741	0. 13	7. 6	N. 54 W.	4. 3	79. 8	....	....	109.
February, 1864	4	29. 178	29. 075	21. 9	20. 3	. 103	. 717	0. 18	7. 5	S. 59 W.	3. 1	......	46. 2	....	77.
March, 1864	4	29. 249	29. 147	22. 7	20. 9	. 102	. 740	0. 19	6. 2	N. 28 E.	2. 7	73. 2	....	40. 1	....
April, 1864	4	29. 347	29. 186	33. 7	31. 9	. 160	. 819	0. 24	7. 8	N. 52 E.	2. 3	42. 3	....	54. 1	....
May, 1864	4	29. 269	29. 043	42. 4	40. 2	. 226	. 817	0. 12	7. 7	N. 9 W.	4. 0	120. 3	....	....	19.
June, 1864	4	29. 430	29. 088	53. 3	50. 3	. 342	. 789	....	3. 1	N. 36 W.	2. 9	71. 0	....	....	50.
July, 1864	4	29. 417	28. 959	61. 1	58. 4	. 458	. 840	0. 23	5. 0	N. 44 W.	2. 2	49. 8	....	....	47.
August, 1864	4	29. 328	28. 825	64. 3	60. 9	. 503	. 813	0. 05	6. 4	N. 26 W.	2. 3	63. 2	....	....	30.
September, 1864	4	29. 361	29. 017	53. 1	50. 6	. 344	. 830	0. 14	6. 5	N. 34 E.	1. 6	39. 0	....	26. 7	....
October, 1864	4	29. 297	29. 071	41. 9	39. 9	. 226	. 828	0. 20	7. 8	N. 49 W.	3. 3	65. 1	....	....	76.
November, 1864	4	29. 297	29. 138	33. 9	31. 8	. 159	. 777	0. 16	8. 5	S. 66 W.	5. 1	......	10. 6	....	151.
December, 1864	4	29. 254	29. 155	22. 0	20. 2	. 099	. 725	0. 19	8. 1	N. 59 W.	5. 2	83. 2	....	....	136.
January, 1865	4	29. 362	29. 296	15. 7	13. 8	. 066	. 667	0. 09	8. 8	N. 46 W.	4. 5	96. 4	....	....	101.
February, 1865	4	29. 451	29. 370	19. 0	17. 2	. 081	. 700	0. 08	8. 1	N. 8 W.	2. 5	70. 1	....	....	9.
March, 1865	4	29. 307	29. 196	24. 7	22. 8	. 111	. 714	0. 22	8. 0	N. 24 W.	2. 9	82. 7	....	....	36.
April, 1865	4	29. 354	29 207	32. 1	30. 0	. 146	. 776	0. 34	6. 7	N. 85 W.	2. 2	5. 7	....	....	61.
May, 1865	4	29. 350	29. 147	40. 1	37. 8	. 203	. 795	0. 11	5. 3	N. 12 E.	1. 0	29. 3	....	6. 0	....
June, 1865	4	29. 367	29. 026	52. 3	50. 2	. 341	. 852	0. 12	7. 2	S. 45 W.	1. 6	......	34. 3	....	34.
July, 1865	4	29. 402	29. 042	55. 4	52. 4	. 360	. 811	0. 10	5. 6	N. 44 W.	2. 9	64. 4	....	....	63.
August, 1865	4	29. 463	29. 057	58. 5	55. 5	. 406	. 813	0. 25	3. 7	N. 40 W.	1. 3	29. 1	....	....	25.
September, 1865	4	29. 448	28. 989	60. 9	58. 3	. 459	. 848	0. 20	5. 6	S. 31 W.	1. 2	......	30. 6	....	18.
October, 1865	4	29. 399	29. 171	42. 9	40. 4	. 228	. 788	0. 18	7. 2	N. 19 E.	3. 7	107. 9	....	38. 1	....
November, 1865	4	29. 420	29. 240	38. 0	35. 4	. 180	. 760	0. 02	7. 1	N. 88 W.	3. 7	4. 2	....	....	106.
December, 1865	....	......	......	....	....	....	....	....	....	....	....	......	....	....	....
Mean of spring	4	29. 313	29. 154	32. 6	30. 6	. 158	. 777	1. 22	6. 9	N. 3 W.	1. 9	353. 5	....	....	30.
Mean of summer	4	29. 401	28. 999	57. 5	54. 6	. 401	. 820	0. 75	5. 2	N. 47 W.	1. 9	243. 2	....	....	251.
Mean of autumn	4	29. 370	29. 104	45. 1	42. 7	. 266	. 805	0. 90	7. 1	N. 58 W.	1. 9	175. 0	....	....	281.
Mean of winter	4	29. 327	29. 234	20. 7	19. 0	. 092	. 715	0. 96	8. 0	N. 55 W.	2. 8	297. 8	....	....	408.
Means of all	4	29. 353	29. 123	39. 0	36. 7	. 233	. 779	3. 83	6. 8	N. 41 W.	2. 0	1069. 5	....	....	969.

Meteorological observations at Thunder Bay Island, &c.—Continued.

Date.	Time of observation.	Pressure reduced to 32° Fahr.		Temp., Fahr.		Vapor.		Am't of rain and melted snow, U. S. inches and decimals.	Am't cloudiness. (10=sky entirely overcast, 0=clear sky.)	Wind.					
		Total U. S. inches and decimals.	Gaseous, U. S. inches and decimals.	Dry bulb.	Wet bulb.	Elasticity, U. S. inches and decimals.	Humidity. Saturation=1.000.			Observed direction; from whence.	Observed velocity; miles per hour.	Resolution of direction and velocity, in miles per hour.			
												N.	S.	E.	W.
	A.M.			°	°					°					
December, 1863	3.30	29.437	29.326	26.0	23.9	.111	.731	....	8.1	N. 48 E.	1.4	29.4	....	33.7	......
January, 1864	3.30	29.278	29.185	20.1	18.2	.093	.752	....	7.6	N. 52 W.	5.2	98.1	....	....	127.8
February, 1864	3.30	29.178	29.075	22.0	20.3	.103	.720	....	7.4	N. 54 W.	3.1	52.7	....	....	73.7
March, 1864	3.30	29.252	29.150	22.6	20.9	.102	.741	....	5.7	N. 23 E.	3.5	98.8	....	42.2	......
April, 1864	3.30	29.346	29.188	33.6	31.8	.158	.810	....	7.6	N. 51 E.	2.0	37.7	....	47.8	......
May, 1864	3.30	29.267	20.042	42.4	40.2	.225	.812	....	7.5	N. 9 W.	4.0	121.0	....	....	19.6
June, 1864	3.30	29.426	29.081	53.4	50.4	.345	.792	....	3.6	N. 38 W.	2.9	69.5	....	....	53.2
July, 1864	3.30	29.416	28.957	61.3	58.5	.460	.837	....	[illegible].8	N. 38 W.	2.4	59.2	....	....	46.9
August, 1864	3.30	29.327	28.825	64.3	60.9	.502	.810	....	6.4	N. 20 W.	2.3	68.7	....	....	25.0
September, 1864	3.30	29.363	29.021	53.1	50.5	.342	.824	....	6.5	N. 58 E.	2.1	32.2	....	52.9	......
October, 1864	3.30	29.295	29.069	42.0	40.0	.226	.826	....	7.1	N. 46 W.	3.3	69.3	....	....	72.9
November, 1864	3.30	29.297	29.139	33.9	31.7	.158	.771	....	8.2	S. 84 W.	5.0	......	16.0	....	148.7
December, 1864	3.30	29.258	29.159	21.9	20.1	.099	.723	....	8.0	N. 57 W.	5.3	88.9	....	....	138.9
January, 1865	3.30	29.364	29.298	15.4	13.6	.065	.661	....	8.5	N. 44 W.	4.4	98.6	....	....	96.5
February, 1865	3.30	29.454	29.374	18.8	17.0	.080	.697	....	8.1	N. 10 W.	2.5	68.8	....	....	12.3
March, 1865	3.30	29.308	29.198	24.5	22.6	.110	.720	....	8.0	N. 23 W.	3.3	92.6	....	....	40.0
April, 1865	3.30	29.357	29.212	32.0	29.9	.146	.774	....	6.7	N. 88 W.	1.9	2.4	....	....	58.0
May, 1865	3.30	29.350	29.150	40.0	37.6	.200	.790	....	5.2	N. 15 E.	1.1	31.4	....	8.8	......
June, 1865	3.30	29.367	29.030	52.0	49.9	.337	.850	....	6.9	S. 25 W.	0.9	......	23.5	....	11.0
July, 1865	3.30	29.404	29.050	55.0	52.0	.354	.806	....	5.6	N. 43 W.	3.0	68.9	....	....	63.8
August, 1865	3.30	29.465	29.060	58.6	55.5	.405	.808	....	3.6	N. 45 W.	1.3	28.9	....	....	28.9
September, 1865	3.30	29.447	28.988	61.0	58.3	.459	.847	....	5.3	S. 28 W.	1.1	......	28.9	....	15.0
October, 1865	3.30	29.399	29.171	42.9	40.4	.228	.769	....	7.2	N. 16 E.	4.4	130.0	....	37.9	......
November, 1865	3.30	29.421	29.240	38.1	35.5	.180	.761	....	7.1	N. 88 W.	3.2	3.8	....	....	92.4
December, 1865	....	......	......	....	....	....	....	....	....	....	....	......	....	....	......
Mean of spring	3.30	29.313	29.157	32.5	30.5	.157	.774	....	6.8	N. 3 W.	2.1	383.9	....	....	16.8
Mean of summer	3.30	29.401	29.000	57.4	54.5	.400	.817	....	5.1	N. 39 W.	1.9	271.7	....	....	228.8
Mean of autumn	3.30	29.370	29.104	45.2	42.7	.265	.803	....	6.9	N. 39 W.	2.1	290.4	....	....	238.2
Mean of winter	3.30	29.328	29.236	20.7	18.8	.092	.714	....	7.9	N. 43 W.	3.4	436.5	....	....	415.5
Means of all	3.30	29.353	29.124	38.9	36.6	.229	.777	....	6.7	N. 32 W.	2.3	1392.5	....	....	899.3
December, 1863	3	29.442	29.332	25.9	23.8	.110	.735	0.25	8.1	N. 4 E.	0.7	20.6	....	1.5	......
January, 1864	3	29.276	29.183	20.2	18.6	.093	.749	0.16	7.7	N. 51 W.	5.2	101.4	....	....	124.7
February, 1864	3	29.180	29.078	22.1	20.4	.102	.714	0.25	7.3	N. 63 W.	4.7	62.0	....	....	124.1
March, 1864	3	29.254	29.152	22.5	20.8	.102	.747	0.18	5.5	N. 15 E.	3.2	95.2	....	26.4	......
April, 1864	3	29.346	29.190	33.4	31.7	.156	.802	0.07	7.6	N. 61 E.	2.0	28.4	....	51.0	......
May, 1864	3	29.267	29.040	42.6	40.3	.227	.811	0.01	7.4	N. 7 W.	4.0	124.7	....	....	16.5
June, 1864	3	29.425	29.079	53.4	50.4	.346	.793	0.17	3.8	N. 30 W.	3.3	89.4	....	....	49.3
July, 1864	3	29.411	28.947	61.5	58.7	.464	.832	0.07	4.5	N. 40 W.	2.5	58.2	....	....	49.4
August, 1864	3	29.326	28.824	64.5	61.0	.502	.806	....	6.2	N. 25 W.	2.2	58.7	....	....	26.4
September, 1864	3	29.365	29.023	53.3	50.6	.342	.820	....	6.1	N. 57 E.	2.6	43.0	....	66.1	......
October, 1864	3	29.295	29.068	42.1	40.0	.227	.823	0.20	7.7	N. 44 W.	3.3	73.8	....	....	71.9
November, 1864	3	29.297	29.137	34.0	31.9	.160	.777	0.28	8.0	S. 81 W.	4.9	......	22.4	....	148.3
December, 1864	3	29.259	29.160	21.8	20.1	.099	.725	0.20	8.0	N. 57 W.	5.6	95.3	....	....	145.4
January, 1865	3	29.366	29.301	15.3	13.4	.063	.659	0.09	8.5	N. 45 W.	4.3	95.7	....	....	94.5
February, 1865	3	29.455	29.375	18.7	16.8	.080	.699	0.12	7.9	N. 10 W.	2.3	64.8	....	....	11.7
March, 1865	3	29.310	29.200	24.5	22.6	.110	.706	0.12	7.8	N. 22 W.	3.4	97.2	....	....	38.7
April, 1865	3	29.360	29.215	31.9	29.9	.145	.772	0.30	6.6	N. 83 W.	1.7	6.8	....	....	50.4
May, 1865	3	29.349	29.149	40.0	37.6	.200	.786	0.13	5.2	N. 2 W.	1.1	33.1	....	....	1.2
June, 1865	3	29.367	29.034	51.7	49.6	.333	.846	0.22	6.5	S. 11 W.	0.8	......	23.0	....	4.4
July, 1865	3	29.405	29.053	54.9	51.8	.352	.802	0.15	5.7	N. 43 W.	2.9	64.8	....	....	61.1
August, 1865	3	29.466	29.062	58.6	55.4	.404	.804	0.25	3.6	N. 49 W.	1.3	25.9	....	....	29.9
September, 1865	3	29.447	28.985	61.1	58.5	.462	.844	0.04	5.0	S. 52 W.	0.9	......	16.8	....	20.9
October, 1865	3	29.399	29.172	42.9	40.4	.227	.787	0.10	7.1	N. 13 E.	5.0	150.9	....	35.5	......
November, 1865	3	29.420	29.240	38.1	35.6	.180	.758	0.02	6.9	N. 87 W.	3.0	4.7	....	....	87.9
December, 1865	....	......	......	....	....	....	....	....	....	....	....	......	....	....	......
Mean of spring	3	29.314	29.158	32.5	30.5	.157	.771	0.81	6.7	N. 5 W.	2.1	385.4	....	....	29.4
Mean of summer	3	29.400	28.999	57.4	54.5	.400	.814	0.86	5.0	N. 38 W.	1.9	274.0	....	....	220.5
Mean of autumn	3	29.370	29.104	45.2	42.8	.266	.801	0.64	6.8	N. 43 W.	1.8	233.2	....	....	227.4
Mean of winter	3	29.330	29.238	20.7	18.8	.091	.713	1.07	7.9	N. 49 W.	3.6	439.8	....	....	498.9
Means of all	3	29.353	29.125	38.9	36.6	.228	.775	3.38	6.6	N. 36 W.	2.2	1332.4	....	....	976.2

Meteorological observations at Thunder Bay Island, &c.—Continued.

Date.	Time of observation.	Pressure reduced to 32° Fahr.		Temp., Fahr.		Vapor.		Am't of rain and melted snow, U. S. inches and decimals.	Am't cloudiness. (10=sky entirely overcast, 0=clear sky.)	Wind.					
		Total, U. S. inches and decimals.	Gaseous, U. S. inches and decimals.	Dry bulb.	Wet bulb.	Elasticity, U. S. inches and decimals.	Humidity. Saturation = 1.000.			Observed direction; from whence.	Observed velocity, miles per hour.	Resolution of direction and velocity, in miles per hour.			
												N.	S.	E.	W.
	A. M.			°	°					°					
December, 1863	2.30	29.439	29.328	26.0	23.9	.111	.731	....	8.1	N. 32 W.	0.7	16.3	....	....	10.6
January, 1864	2.30	29.277	29.183	20.3	18.6	.094	.741	....	7.7	N. 54 W.	5.4	100.0	....	....	136.8
February, 1864	2.30	29.184	29.080	22.2	20.5	.104	.731	....	7.2	N. 58 W.	2.7	49.1	....	....	78.0
March, 1864	2.30	29.258	29.155	22.7	21.0	.102	.740	....	5.7	N. 12 E.	3.0	83.7	....	19.6	......
April, 1864	2.30	29.347	29.191	33.6	31.7	.156	.805	....	7.5	N. 62 E.	1.8	25.9	....	47.7	......
May, 1864	2.30	29.267	29.041	42.7	40.4	.226	.807	....	7.6	N. 6 W.	4.0	124.2	....	....	13.5
June, 1864	2.30	29.427	29.079	53.5	50.5	.348	.792	....	3.6	N. 38 W.	2.9	69.2	....	....	32.1
July, 1864	2.30	29.411	28.[illegible]44	61.8	58.9	.466	.835	....	4.4	N. 43 W.	2.5	56.8	....	....	53.0
August, 1864	2.30	29.326	28.827	64.7	61.1	.499	.797	....	6.0	N. 28 W.	2.5	67.0	....	....	36.6
September, 1864	2.30	29.364	29.019	53.5	50.8	.345	.820	....	5.9	N. 59 E.	2.6	39.0	....	66.9	......
October, 1864	2.30	29.293	29.066	42.1	40.0	.227	.826	....	7.5	N. 44 W.	3.6	82.5	....	....	76.5
November, 1864	2.30	29.296	29.136	34.0	31.8	.160	.779	....	7.8	S. 82 W.	4.9	......	20.3	....	146.6
December, 1864	2.30	29.259	29.159	22.0	20.2	.100	.722	....	8.1	N. 57 W.	5.7	95.5	....	....	147.9
January, 1865	2.30	29.366	29.302	15.3	13.4	.064	.654	....	8.5	N. 45 W.	4.0	87.6	....	....	88.8
February, 1865	2.30	29.456	29.377	18.8	16.9	.079	.692	....	8.0	N. 10 W.	2.2	60.5	....	....	10.9
March, 1865	2.30	29.311	29.201	24.6	22.6	.100	.707	....	7.8	N. 16 W.	3.1	91.4	....	....	26.3
April, 1865	2.30	29.362	25.217	32.1	29.9	.144	.767	....	6.6	N. 44 W.	1.0	22.4	....	....	21.2
May, 1865	2.30	29.350	29.151	40.1	37.6	.199	.782	....	5.2	N. 5 W.	1.5	46.6	....	....	3.7
June, 1865	2.30	29.367	29.033	51.9	49.7	.334	.842	....	6.1	S. 34 W.	0.8	......	21.1	....	14.4
July, 1865	2.30	29.406	29.050	55.2	51.9	.356	.793	....	5.7	N. 39 W.	2.8	67.8	....	....	54.9
August, 1865	2.30	29.464	29.062	58.7	55.4	.402	.799	....	3.4	N. 45 W.	1.2	26.3	....	....	26.1
September, 1865	2.30	29.448	28.987	61.2	58.5	.461	.840	....	4.9	S. 56 W.	0.9	......	15.1	....	22.6
October, 1865	2.30	29.399	29.172	43.0	40.4	.227	.780	....	7.0	N. 13 E.	5.3	160.2	....	37.6	......
November, 1865	2.30	29.420	29.241	38.2	35.6	.179	.749	....	6.8	N. 88 W.	3.0	2.5	....	....	86.0
December, 1865	....	......	......	....	....	....	....	....	....	....	....	......	....	....	......
Mean of spring	2.30	29.316	29.159	32.6	30.5	.156	.768	....	6.7	North	2.2	299.5	....	2.6	......
Mean of summer	2.30	29.400	28.999	57.6	54.6	.401	.809	....	4.9	N. 28 W.	2.2	353.4	....	....	192.9
Mean of autumn	2.30	29.370	29.103	45.3	42.8	.266	.799	....	6.6	N. 52 W.	2.3	248.8	....	....	331.7
Mean of winter	2.30	29.330	29.238	20.8	18.9	.092	.712	....	7.9	N. 48 W.	3.5	409.0	....	....	473.0
Means of all	2.30	29.354	29.125	39.1	36.7	.229	.772	....	6.6	N. 36 W.	2.4	1410.7	....	....	1007.0
December, 1863	2	29.441	29.328	26.2	24.1	.113	.733	0.27	7.7	S. 89 W.	1.3	......	7.1	....	40.3
January, 1864	2	29.275	29.181	20.5	18.8	.094	.736	0.15	7.6	N. 51 W.	5.2	99.2	....	....	124.4
February, 1864	2	29.187	29.084	22.3	20.5	.103	.719	0.32	7.2	N. 62 W.	2.8	38.5	....	....	71.0
March, 1864	2	29.262	29.159	22.9	21.1	.102	.738	0.18	5.6	N. 1 E.	2.8	88.3	....	1.6	......
April, 1864	2	29.348	29.191	33.7	31.8	.157	.805	0.20	7.5	N. 59 E.	1.8	27.9	....	47.0	......
May, 1864	2	29.269	29.042	42.8	40.5	.227	.803	0.06	7.5	N. 5 W.	4.3	139.6	....	....	11.8
June, 1864	2	29.424	29.077	53.8	50.6	.347	.782	0.20	3.6	N. 24 W.	3.2	86.2	....	....	39.3
July, 1864	2	29.408	28.940	62.0	59.1	.468	.830	....	4.4	N. 40 W.	2.1	50.9	....	....	43.0
August, 1864	2	29.327	28.827	64.9	61.1	.500	.792	....	5.6	N. 30 W.	2.4	65.4	....	....	36.9
September, 1864	2	29.364	29.017	53.6	50.8	.346	.813	0.11	5.8	N. 64 E.	2.2	29.5	....	59.5	......
October, 1864	2	29.294	29.068	42.2	40.0	.226	.817	0.17	7.5	N. 40 W.	3.7	90.0	....	....	74.0
November, 1864	2	29.295	29.132	34.1	32.0	.163	.774	0.23	7.7	S. 82 W.	5.0	......	21.8	....	148.1
December, 1864	2	29.260	29.160	22.0	20.2	.100	.725	0.20	8.0	N. 63 W.	5.2	75.5	....	....	144.2
January, 1865	2	29.368	29.303	15.5	13.6	.065	.656	0.08	4.8	N. 43 W.	4.1	92.4	....	....	87.1
February, 1865	2	29.457	29.378	19.1	17.2	.079	.683	0.08	7.8	N. 10 W.	2.2	60.8	....	....	10.5
March, 1865	2	29.312	29.202	24.7	22.7	.110	.702	0.15	7.7	N. 13 W.	3.3	101.7	....	....	23.6
April, 1865	2	29.360	29.215	32.3	30.1	.145	.764	0.35	6.3	N. 37 W.	0.8	18.1	....	....	13.8
May, 1865	2	29.350	29.153	40.3	37.7	.198	.772	0.10	5.2	N. 12 W.	1.7	51.9	....	....	10.7
June, 1865	2	29.367	29.032	52.1	49.8	.335	.839	0.19	5.9	S. 36 W.	0.6	......	16.6	....	12.0
July, 1865	2	29.407	29.052	55.5	52.2	.354	.789	0.27	5.8	N. 35 W.	2.8	71.7	....	....	49.5
August, 1865	2	29.463	29.063	58.8	55.4	.400	.794	0.10	3.0	N. 43 W.	1.6	35.5	....	....	33.6
September, 1865	2	29.449	28.988	61.5	58.6	.461	.833	....	4.7	S. 58 W.	0.8	......	13.9	....	22.2
October, 1865	2	29.399	29.171	43.1	40.5	.228	.781	0.15	7.1	N. 12 E.	5.3	160.9	....	34.3	......
November, 1865	2	29.421	29.242	38.3	35.6	.179	.745	0.02	6.6	West	3.5	......	0.9	....	100.2
December, 1865	....	......	......	....	....	....	....	....	....	....	....	......	....	....	......
Mean of spring	2	29.317	29.160	32.8	30.6	.156	.764	1.04	6.6	N. 2 W.	2.3	427.5	....	....	10.5
Mean of summer	2	29.399	28.998	57.8	54.7	.401	.804	0.76	4.7	N. 39 W.	2.1	293.1	....	....	214.3
Mean of autumn	2	29.370	29.103	45.5	42.9	.267	.794	0.68	6.6	N. 47 W.	1.9	243.8	....	....	250.7
Mean of winter	2	29.331	29.239	20.9	19.1	.092	.709	1.10	7.2	N. 53 W.	3.3	359.3	....	....	477.5
Means of all	2	29.354	29.125	39.2	36.8	.229	.768	3.58	6.3	N. 36 W.	2.2	1323.7	....	....	953.0

Meteorological observations at Thunder Bay Island, &c.—Continued.

Date.	Time of observation.	Pressure reduced to 32° Fahr.		Temp., Fahr.		Vapor.		Am't of rain and melted snow, U. S. inches and decimals.	Am't cloudiness. (10=sky entirely overcast, 0=clear sky.)	Wind.					
		Total, U. S. inches and decimals.	Gaseous, U. S. inches and decimals.	Dry bulb.	Wet bulb.	Elasticity, U. S. inches and decimals.	Humidity. Saturation = 1.000.			Observed direction; from whence.	Observed velocity; miles per hour.	Resolution of direction and velocity, in miles per hour.			
												N.	S.	E.	W.
	A. M.			°	°					°					
December, 1863	1.30	29.442	29.328	26.3	24.2	.114	.741	....	7.4	N. 86 W.	1.6	3.7	....	....	48.9
January, 1864	1.30	29.273	29.180	20.8	19.0	.093	.727	....	7.3	N. 56 W.	4.8	85.0	....	....	124.7
February, 1864	1.30	29.188	29.085	22.3	20.5	.103	.721	....	7.6	N. 58 W.	2.7	40.8	....	....	65.6
March, 1864	1.30	29.261	29.158	23.2	21.4	.104	.742	....	5.7	N. 2 E.	3.7	114.3	....	4.7	....
April, 1864	1.30	29.343	29.184	34.1	32.1	.159	.802	....	7.5	N. 53 E.	1.8	31.6	....	42.3	....
May, 1864	1.30	29.272	29.044	43.1	40.6	.228	.800	....	7.5	N. 4 W.	4.5	138.9	....	....	9.1
June, 1864	1.30	29.424	29.076	54.1	50.8	.348	.781	....	3.6	N. 6 W.	2.8	86.7	....	....	8.6
July, 1864	1.30	29.407	28.937	62.3	59.3	.470	.825	....	4.2	N. 35 W.	2.0	51.9	....	....	36.9
August, 1864	1.30	29.328	28.825	65.2	61.3	.503	.789	....	5.5	N. 29 W.	2.6	69.9	....	....	39.3
September, 1864	1.30	29.366	29.010	53.9	51.0	.356	.808	....	5.8	N. 74 E.	2.2	18.0	....	64.7	....
October, 1864	1.30	29.296	29.071	42.3	40.1	.225	.809	....	7.6	N. 42 W.	3.5	79.8	....	....	71.8
November, 1864	1.30	29.296	29.135	34.2	32.1	.161	.778	....	7.8	S. 84 W.	1.3	....	14.6	....	137.9
December, 1864	1.30	29.263	29.163	22.2	20.4	.100	.720	....	8.1	N. 65 W.	5.6	74.4	....	....	158.9
January, 1865	1.30	29.368	29.302	15.8	13.9	.066	.658	....	8.1	N. 41 W.	4.1	98.1	....	....	84.9
February, 1865	1.30	29.457	29.377	19.4	17.5	.080	.682	....	7.8	N. 4 E.	2.1	58.7	....	3.9	....
March, 1865	1.30	29.314	29.204	25.0	22.9	.110	.703	....	7.9	N. 21 W.	3.4	99.2	....	....	39.0
April, 1865	1.30	29.367	29.222	32.7	30.4	.145	.757	....	6.0	N. 14 W.	0.5	14.3	....	....	3.6
May, 1865	1.30	29.350	29.151	40.6	37.9	.199	.769	....	5.2	N. 2 E.	1.9	60.2	....	1.7	....
June, 1865	1.30	20.366	29.031	52.4	50.0	.335	.831	....	5.9	S. 32 W.	0.7	....	18.9	....	11.9
July, 1865	1.30	29.405	29.044	56.1	52.7	.361	.783	....	5.9	N. 34 W.	2.6	68.2	....	....	45.9
August, 1865	1.30	29.461	29.060	59.0	55.6	.401	.791	....	2.8	N. 45 W.	1.5	32.9	....	....	32.6
September, 1865	1.30	29.451	28.990	61.5	58.6	.461	.833	....	4.4	S. 64 W.	1.1	....	14.1	....	28.8
October, 1865	1.30	29.398	29.171	43.3	40.7	.227	.775	....	7.3	N. 16 E.	4.9	147.5	....	43.2	....
November, 1865	1.30	29.422	29.244	38.5	35.7	.178	.741	....	6.3	S. 84 W.	2.8	....	7.9	....	79.3
December, 1865	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Mean of spring	1.30	29.318	29.160	33.1	30.9	.157	.762	....	6.6	North	2.5	458.5	....	....	3.1
Mean of summer	1.30	29.399	28.995	58.2	54.9	.403	.800	....	4.6	N. 29 W.	1.8	290.7	....	....	175.2
Mean of autumn	1.30	29.371	29.103	45.6	43.0	.268	.791	....	6.5	N. 45 W.	1.6	208.7	....	....	209.9
Mean of winter	1.30	29.332	29.239	21.1	19.2	.093	.708	....	7.7	N. 55 W.	3.3	360.7	....	....	479.1
Means of all	1.30	29.355	29.124	39.5	37.0	.230	.765	....	6.3	N. 34 W.	2.2	1318.6	....	....	867.3
December, 1863	1	29.444	29.329	26.4	24.4	.115	.744	0.19	7.3	S. 84 W.	1.4	....	4.1	....	43.7
January, 1864	1	29.272	29.178	21.0	19.2	.094	.722	0.09	7.6	N. 60 W.	4.9	76.3	....	....	132.3
February, 1864	1	29.191	29.089	22.4	20.6	.102	.718	0.35	7.7	N. 55 W.	2.7	46.2	....	....	65.2
March, 1864	1	29.262	29.159	23.4	21.5	.102	.725	0.08	5.9	N. 1 W.	3.0	92.7	....	....	2.5
April, 1864	1	29.350	29.191	34.1	32.1	.159	.802	0.02	7.4	N. 46 E.	1.8	38.3	....	39.4	....
May, 1864	1	29.374	29.048	43.2	40.6	.226	.792	0.30	7.0	N. 5 W.	3.8	120.4	....	....	9.8
June, 1864	1	29.430	29.071	54.5	51.1	.349	.770	....	3.6	N. 32 W.	3.1	78.2	....	....	49.6
July, 1864	1	29.403	28.926	62.5	59.4	.477	.824	....	4.3	N. 41 W.	1.8	42.4	....	....	36.4
August, 1864	1	29.329	28.825	65.6	61.6	.504	.780	....	5.7	N. 28 W.	2.6	71.8	....	....	37.9
September, 1864	1	29.364	29.018	54.0	51.1	.346	.806	0.18	5.7	N. 72 E.	2.5	23.0	....	71.7	....
October, 1864	1	29.297	29.072	42.5	40.2	.225	.804	0.16	7.8	N. 36 W.	3.3	81.6	....	....	59.2
November, 1864	1	29.296	29.135	34.4	32.2	.161	.774	0.25	7.9	S. 80 W.	4.8	....	24.4	....	141.1
December, 1864	1	29.263	29.164	22.3	20.5	.099	.720	0.07	8.1	N. 63 W.	5.9	82.8	....	....	163.8
January, 1865	1	29.366	29.299	16.3	14.3	.066	.652	0.08	8.1	N. 41 W.	4.0	93.3	....	....	82.7
February, 1865	1	29.458	29.377	19.9	17.9	.081	.681	0.10	8.1	N. 20 W.	1.6	42.7	....	....	15.9
March, 1865	1	29.315	29.203	25.3	23.3	.112	.708	0.16	7.5	N. 23 W.	3.5	100.5	....	....	42.3
April, 1865	1	29.369	29.220	33.1	30.8	.148	.759	0.42	6.0	N. 13 W.	0.6	18.6	....	....	4.3
May, 1865	1	29.352	29.153	41.0	38.2	.199	.761	0.12	4.9	N. 2 E.	2.2	69.0	....	2.3	....
June, 1865	1	29.366	29.029	52.8	50.3	.337	.826	0.42	5.8	S. 9 W.	0.7	....	21.5	....	3.5
July, 1865	1	29.408	29.047	56.8	53.1	.361	.772	0.09	6.0	N. 32 W.	2.6	67.9	....	....	42.2
August, 1865	1	29.460	29.058	59.2	55.7	.402	.791	....	3.0	N. 49 W.	1.5	30.4	....	....	35.0
September, 1865	1	29.452	28.991	61.6	58.7	.461	.830	....	4.3	S. 45 W.	0.8	....	18.6	....	18.5
October, 1865	1	29.400	29.169	43.6	40.8	.231	.770	0.12	7.5	N. 14 E.	4.5	135.1	....	33.8	....
November, 1865	1	29.424	29.245	38.6	35.6	.179	.741	0.02	6.4	S. 78 W.	2.1	....	12.9	....	58.6
December, 1865	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Mean of spring	1	29.320	29.162	33.3	31.1	.158	.758	1.10	6.4	N. 2 W.	2.4	439.5	....	....	17.2
Mean of summer	1	29.399	28.993	58.6	55.2	.405	.794	0.51	4.7	N. 29 W.	2.3	269.2	....	....	204.6
Mean of autumn	1	29.372	29.105	45.8	43.1	.267	.787	0.73	6.6	N. 42 W.	1.4	183.8	....	....	171.9
Mean of winter	1	29.332	29.239	21.4	19.5	.093	.706	0.88	7.8	N. 56 W.	3.4	337.2	....	....	503.6
Means of all	1	29.356	29.125	39.8	37.2	.231	.761	3.22	6.4	N. 35 W.	2.1	1229.7	....	....	897.3

TABLE K.—*Meteorological observations at Thunder Bay Island, in Lake Huron, Michigan, made under the direction of Col. W F. Raynolds, U. S. corps of engineers, superintendent of the survey of the northern and north-western lakes.*

SPRING.

Time of observation.	Pressure reduced to 32° Fahr.		Temp., Fahr.		Vapor.		Am't of rain and melted snow, U. S. inches and decimals.	Am't cloudiness. (10=sky entirely overcast, 0=clear sky.)	Wind.					
	Total, U. S. inches and decimals.	Gaseous, U. S. inches and decimals.	Dry bulb.	Wet bulb.	Elasticity, U. S. inches and decimals.	Humidity. Saturation = 1.000.			Observed direction; from whence.	Observed velocity; miles per hour.	Resolution of direction and velocity, in miles per hour.			
											N.	S.	E.	W.
			°	°					°					
0.30 a.m.	29.322	29.163	33.6	31.3	.158	.754	......	6.5	N. 2 W.	2.5	458.8	....	....	22.2
1.00 a.m.	29.320	29.162	33.3	31.1	.158	.758	1.10	6.4	N. 2 W.	2.4	439.5	....	....	17.2
1.30 a.m.	29.318	29.160	33.1	30.9	.157	.765	......	6.6	North ..	2.5	458.5	....	....	3.1
2.00 a.m.	29.317	29.160	32.8	30.6	.156	.764	1.04	6.6	N. 2 W.	2.3	427.5	....	....	10.5
2.30 a.m.	29.316	29.159	32.6	30.5	.156	.768	......	6.7	North ..	2.2	399.5	....	2.6	......
3.00 a.m.	29.314	29.158	32.5	30.5	.157	.771	0.81	6.7	N. 5 W.	2.1	385.4	....	....	29.4
3.30 a.m.	29.313	29.157	32.5	30.5	.157	.774	......	6.8	N. 3 W.	2.1	383.9	....	....	16.8
4.00 a.m.	29.313	29.154	32.6	30.6	.158	.777	1.22	6.9	N. 3 W.	1.9	353.5	....	....	20.4
4.30 a.m.	29.311	29.152	32.7	30.8	.159	.781	......	7.2	N. 3 E..	2.1	383.0	....	20.5	......
5.00 a.m.	29.310	29.150	32.9	30.9	.160	.782	0.76	7.2	N. 6 E..	1.9	352.1	....	30.9	......
5.30 a.m.	29.312	29.149	33.2	31.2	.163	.783	......	7.2	N. 3 E..	1.9	338.1	....	19.3	......
6.00 a.m.	29.313	29.148	33.7	31.7	.165	.778	0.82	7.3	N. 6 E..	1.8	324.5	....	32.4	......
6.30 a.m.	29.316	29.149	34.2	32.1	.168	.774	......	7.3	N. 3 E..	1.8	323.3	....	18.0	......
7.00 a.m.	29.319	29.148	35.2	32.8	.170	.763	0.84	7.3	N. 3 E..	1.7	321.0	....	20.4	......
7.30 a.m.	29.318	29.148	36.0	33.5	.173	.755	......	7.7	N. 7 E..	1.6	295.5	....	37.6	......
8.00 a.m.	29.325	29.148	36.9	34.2	.176	.745	0.52	7.4	N. 11 E.	1.5	275.4	....	52.4	......
8.30 a.m.	29.327	29.147	37.7	34.8	.180	.740	......	7.3	N. 15 E.	1.6	274.7	....	83.9	......
9.00 a.m.	29.328	29.147	38.3	35.3	.181	.730	0.41	7.1	N. 17 E.	1.4	244.0	....	64.9	......
9.30 a.m.	29.329	29.148	38.8	35.7	.181	.720	......	7.0	N. 12 E.	1.4	250.2	....	63.4	......
10.00 a.m.	29.331	29.148	39.5	36.2	.183	.711	0.48	7.0	N. 20 E.	1.5	250.5	....	97.4	......
10.30 a.m.	29.328	29.143	40.0	36.5	.185	.701	......	7.1	N. 13 E.	1.3	239.2	....	54.5	......
11.00 a.m.	29.327	29.143	40.5	36.8	.184	.691	0.45	7.1	N. 24 E.	1.2	195.4	....	82.5	......
11.30 a.m.	29.325	29.141	40.9	37.1	.184	.681	......	7.1	N. 15 E.	1.1	196.7	....	56.0	......
12.00 m...	29.324	29.140	41.1	37.2	.184	.672	0.59	7.1	N. 17 E.	1.4	235.4	....	70.7	......
12.30 p.m.	29.321	29.138	41.4	37.4	.183	.666	......	7.1	N. 14 E.	1.2	229.1	....	51.0	......
1.00 p.m.	29.317	29.135	41.6	37.4	.183	.657	0.42	7.1	N. 19 E.	1.5	252.4	....	87.1	......
1.30 p.m.	29.313	29.132	41.7	37.5	.181	.651	......	7.1	N. 17 E.	1.7	296.6	....	83.7	......
2.00 p.m.	29.310	29.129	41.9	37.6	.181	.648	0.59	7.0	N. 18 E.	1.6	269.9	....	92.6	......
2.30 p.m.	29.307	29.125	41.8	37.5	.181	.649	......	7.1	N. 26 E.	1.6	259.9	....	120.2	......
3.00 p.m.	29.305	29.125	41.8	37.4	.179	.644	0.57	7.1	N. 17 E.	1.7	301.5	....	97.5	......
3.30 p.m.	29.304	29.125	41.7	37.3	.179	.644	......	7.2	N. 17 E.	1.8	307.1	....	92.5	......
4.00 p.m.	29.304	29.126	41.4	37.1	.178	.645	0.81	7.2	N. 13 E.	1.8	321.3	....	76.4	......
4.30 p.m.	29.305	29.127	41.0	36.8	.179	.658	......	7.0	N. 10 E.	1.7	311.7	....	55.1	......
5.00 p.m.	29.307	29.130	40.4	36.4	.177	.664	0.49	7.1	N. 11 E.	1.6	291.7	....	55.8	......
5.30 p.m.	29.307	29.131	39.8	36.0	.176	.676	......	7.1	N. 7 E..	1.6	292.6	....	42.9	......
6.00 p.m.	29.309	29.136	39.2	35.4	.172	.679	0.52	6.9	N. 3 E..	1.6	287.4	....	16.3	......
6.30 p.m.	29.312	29.142	38.5	34.9	.170	.685	......	7.0	N. 1 E..	1.7	306.7	....	3.5	......
7.00 p.m.	29.312	29.144	37.9	34.4	.168	.691	0.48	7.0	N. 3 W.	2.0	366.4	....	....	20.3
7.30 p.m.	29.316	29.149	37.2	34.0	.166	.702	......	6.9	N. 2 W.	2.7	496.1	....	....	23.0
8.00 p.m.	29.317	29.151	36.8	33.6	.165	.707	0.74	6.7	North ..	2.5	455.1	....	....	3.5
8.30 p.m.	29.321	29.156	36.3	33.4	.165	.717	......	6.7	N. 15 E.	2.6	472.0	....	13.4	......
9.00 p.m.	29.321	29.157	36.0	33.1	.164	.725	0.69	6.5	North ..	2.4	448.1	....	....	2.5
9.30 p.m.	29.322	29.159	35.7	32.9	.163	.729	......	6.5	North ..	2.4	450.1	....	....	......
10.00 p.m.	29.324	29.161	35.4	32.7	.163	.734	0.61	6.4	N. 1 E..	2.4	441.5	....	5.6	......
10.30 p.m.	29.324	29.162	35.1	32.5	.162	.738	......	6.2	N. 1 W.	2.5	442.6	....	....	9.0
11.00 p.m.	29.324	29.161	34.8	32.3	.162	.742	0.49	6.3	N. 2 W.	2.4	448.4	....	....	21.2
11.30 p.m.	29.322	29.160	34.6	32.1	.161	.745	......	6.3	N. 7 W.	2.4	441.3	....	....	47.0
12.00 p.m.	29.321	29.160	34.3	31.8	.160	.757	1.06	6.4	N. 5 W.	2.4	438.0	....	....	42.1
Mean 7,2,9	29.317	29.145	37.7	34.5	.172	.712	......	6.9	N. 6 E..	1.9	1039.0	....	110.5	......
Mean of all	29.317	29.147	37.1	33.4	.170	.716	16.51	6.9	N. 6 E..	1.9	16433.1	....	1412.8	......

Meteorological observations at Thunder Bay Island, &c.—Continued.

SUMMER.

Time of observation.	Pressure reduced to 32° Fahr.		Temp., Fahr.		Vapor.		Amount of rain and melted snow, U. S. inches and decimals.	Amount cloudiness. (10 = sky entirely overcast, 0 = clear sky.)	Wind.					
	Total, U. S. inches and decimals.	Gaseous, U. S. inches and decimals.	Dry bulb.	Wet bulb.	Elasticity, U. S. inches and decimals.	Humidity. Saturation = 1,000.			Observed direction; from whence.	Observed velocity; miles per hour.	Resolution of direction and velocity, in miles per hour.			
											N.	S.	E.	W.
			°	°					°					
0.30 a.m.	29.398	28.992	58.9	55.4	.405	.786	......	4.6	N. 34 W.	1.8	290.8	....	....	184.9
1.00 a.m.	29.399	28.993	58.6	55.2	.405	.794	0.51	4.7	N. 29 W.	2.3	269.2	....	....	204.6
1.30 a.m.	29.399	28.995	58.2	54.9	.403	.800	......	4.6	N. 29 W.	1.8	290.7	....	....	175.2
2.00 a.m.	29.399	28.998	57.8	54.7	.401	.804	0.76	4.7	N. 39 W.	2.1	293.1	....	....	214.3
2.30 a.m.	29.400	28.999	57.6	54.6	.401	.809	......	4.9	N. 28 W.	2.2	353.4	....	....	192.9
3.00 a.m.	29.400	28.999	57.4	54.5	.400	.814	0.86	5.0	N. 38 W.	1.9	274.0	....	....	220.5
3.30 a.m.	29.401	29.000	57.4	54.5	.400	.817	......	5.1	N. 39 W.	1.9	271.7	....	....	228.8
4.00 a.m.	29.401	28.999	57.5	54.6	.401	.820	0.75	5.2	N. 47 W.	1.9	243.2	....	....	251.5
4.30 a.m.	29.401	28.997	57.5	54.7	.404	.821	......	5.4	N. 43 W.	1.9	257.0	....	....	239.4
5.00 a.m.	29.403	28.997	57.7	54.8	.405	.821	0.74	5.5	N. 40 W.	1.7	232.6	....	....	200.6
5.30 a.m.	29.404	28.996	58.1	55.1	.408	.815	......	5.7	N. 40 W.	1.6	216.9	....	....	189.7
6.00 a.m.	29.406	28.991	58.8	55.8	.415	.812	0.51	5.8	N. 42 W.	1.5	193.5	....	....	175.5
6.30 a.m.	29.409	28.984	59.9	56.5	.424	.800	......	5.6	N. 38 W.	1.3	170.3	....	....	154.2
7.00 a.m.	29.411	28.978	61.1	57.4	.433	.782	0.43	5.6	N. 42 W.	1.2	157.4	....	....	145.8
7.30 a.m.	29.413	28.974	62.2	58.1	.439	.766	......	5.7	N. 38 W.	1.3	177.1	....	....	147.1
8.00 a.m.	29.415	28.965	63.3	58.9	.449	.754	0.21	5.6	N. 35 W.	1.2	177.2	....	....	128.8
8.30 a.m.	29.416	28.961	64.3	59.4	.445	.737	......	5.6	N. 38 W.	1.2	166.9	....	....	120.2
9.00 a.m.	29.416	28.958	65.1	60.0	.458	.723	0.02	5.5	N. 26 W.	0.9	152.8	....	....	79.8
9.30 a.m.	29.417	28.957	65.8	60.3	.460	.716	......	5.7	N. 26 W.	0.9	251.6	....	....	81.1
10.00 a.m.	29.417	28.955	66.5	60.6	.462	.693	0.07	5.5	N. 26 W.	0.7	111.3	....	....	66.3
10.30 a.m.	29.417	28.955	67.1	60.8	.461	.676	......	5.5	N. 22 W.	0.5	107.8	....	....	45.6
11.00 a.m.	29.416	28.949	67.7	61.1	.467	.671	0.07	5.5	N. 18 E.	0.3	58.8	....	9.9	......
11.30 a.m.	29.415	28.946	68.1	61.2	.466	.664	......	5.6	N. 22 E.	0.5	104.8	....	38.0	......
12.00 m...	29.412	28.946	68.6	61.4	.465	.656	0.04	5.7	N. 45 E.	0.4	51.3	....	58.3	......
0.30 p.m.	29.408	28.946	68.9	61.6	.463	.642	......	5.7	N. 79 E.	0.5	18.0	....	89.5	......
1.00 p.m.	29.406	28.943	69.2	61.7	.463	.634	0.39	5.8	N. 59 E.	0.6	47.5	....	89.0	......
1.30 p.m.	29.402	28.943	69.3	61.7	.459	.627	......	5.9	S. 79 E.	0.5	....	19.2	92.8	......
2.00 p.m.	29.398	28.937	69.6	61.8	.461	.623	0.44	5.8	N. 80 E.	0.6	11.6	....	114.1	......
2.30 p.m.	29.394	28.935	69.7	61.7	.459	.620	......	5.8	East....	0.4	1.8	....	78.8	......
3.00 p.m.	29.391	28.933	69.5	61.7	.458	.624	1.09	6.0	N. 34 E.	0.4	51.9	....	41.2	......
3.30 p.m.	29.389	28.932	69.5	61.2	.457	.627	......	6.0	N. 14 E.	0.4	78.7	....	22.1	......
4.00 p.m.	29.387	28.932	68.8	61.3	.455	.632	0.91	5.8	N. 22 E.	0.5	98.8	....	43.0	......
4.30 p.m.	29.385	28.931	68.4	61.0	.453	.641	......	5.8	N. 26 E.	0.7	112.1	....	46.6	......
5.00 p.m.	29.384	28.934	67.7	60.7	.450	.648	0.59	5.8	N. 34 E.	0.4	54.6	....	41.3	......
5.30 p.m.	29.384	28.938	67.0	60.2	.445	.659	......	5.8	N. 34 E.	0.4	56.1	....	44.8	......
6.00 p.m.	29.383	28.941	66.3	59.9	.441	.671	0.42	6.0	N. 53 E.	0.5	61.0	....	73.4	......
6.30 p.m.	29.383	28.943	65.3	59.3	.439	.683	......	6.1	N. 34 E.	0.8	117.0	....	79.1	......
7.00 p.m.	29.384	28.952	64.4	58.8	.432	.693	0.49	6.4	N. 23 E.	0.8	122.0	....	53.0	......
7.30 p.m.	29.385	28.957	63.7	58.3	.428	.705	......	6.2	N. 12 E.	0.9	168.1	....	47.1	......
8.00 p.m.	29.386	28.961	63.0	57.9	.425	.717	0.60	6.0	N. 2 E..	1.0	178.2	....	6.6	......
8.30 p.m.	29.388	28.966	62.4	57.5	.422	.728	......	5.6	North ..	1.2	225.3	....	1.3	......
9.00 p.m.	29.390	28.971	61.8	57.2	.419	.737	0.90	5.2	N. 9 W..	1.3	239.1	....	....	29.3
9.30 p.m.	29.393	28.975	61.3	56.9	.417	.745	......	4.9	N. 8 W..	1.4	263.3	....	....	32.2
10.00 p.m.	29.395	28.981	60.8	56.6	.414	.754	0.78	4.7	N. 11 W.	1.6	292.2	....	....	51.8
10.30 p.m.	29.396	28.983	60.4	56.3	.412	.760	......	4.6	N. 22 W.	1.6	276.7	....	....	104.7
11.00 p.m.	29.397	28.987	60.0	56.1	.410	.767	0.72	4.5	N. 25 W.	1.6	279.5	....	....	127.3
11.30 p.m.	29.398	28.987	59.5	55.9	.410	.773	......	4.5	N. 33 W.	1.7	249.7	....	....	168.0
12.00 m...	29.397	28.988	59.3	55.8	.410	.784	0.85	4.5	N. 35 W.	1.7	253.3	....	....	185.1
Mean 7,2,9	29.400	28.962	64.2	58.8	.438	.714	......	5.5	N. 8 W..	0.7	408.1	....	....	61.0
Mean of all	29.408	28.966	63.4	58.2	.434	.725	13.15	5.4	N. 24 W.	1.0	8020.7	....	....	3175.3

Meteorological observations at Thunder Bay Island, &c.—**Continued.**

AUTUMN.

Time of observation.	Pressure reduced to 32° Fahr.		Temp., Fahr.		Vapor.		Amount of rain and melted snow, U. S. inches and decimals.	Amount cloudiness. (10=sky entirely overcast, 0=clear sky.)	Wind.					
	Total, U. S. inches and decimals.	Gaseous, U. S. inches and decimals.	Dry bulb.	Wet bulb.	Elasticity, U. S. inches and decimals.	Humidity. Saturation =1.000.			Observed direction; from whence.	Observed velocity; miles per hour.	Resolution of direction a velocity, in miles p hour.			
											N.	S.	E.	W.
			°	°					°					
0.30 a.m.	29.373	29.104	45.9	43.3	.268	.787	......	6.7	N. 1 W.	1.2	227.2	....	....	5.
1.00 a.m.	29.372	29.105	45.8	43.1	.267	.787	0.73	6.6	N. 42 W.	1,4	183.8	....	....	171.
1.30 a.m.	29.371	29.103	45.6	43.0	.268	.791	......	6.5	N. 45 W.	1.6	208.7	....	....	[illegible]
2.00 a.m.	29.370	29.103	45.5	42.9	.267	.794	0.68	6.6	N. 47 W.	1.9	243.8	....	....	250.
2.30 a.m.	29.370	29.103	45.3	42.8	.266	.799	......	6.6	N. 52 W.	2.3	248.8	....	....	330.
3.00 a.m.	29.370	29.104	45.2	42.8	.266	.801	0.64	6.8	N. 43 W.	1.8	233.2	....	....	[illegible]
3.30 a.m.	29.370	29.104	45.2	42.7	.265	.803	......	6.9	N. 39 W.	2.1	290.4	....	....	[illegible]
4.00 a.m.	29.370	29.104	45.1	42.7	.266	.805	0.90	7.1	N. 58 W.	1.9	175.0	....	....	[illegible]
4.30 a.m.	29.370	29.105	45.0	42.7	.266	.806	......	7.2	N. 87 W.	1.8	154.3	....	....	[illegible]
5.00 a.m.	29.370	29.104	45.0	42.7	.249	.809	0.85	7.3	N. 87 W.	1.8	141.0	....	....	[illegible]
5.30 a.m.	29.371	29.103	45.1	42.8	.268	.810	......	7.5	N. 87 W.	1.7	139.4	....	....	[illegible]
6.00 a.m.	29.372	29.102	45.1	42.9	.269	.810	0.87	7.7	N. 60 W.	1.6	153.9	....	....	254.
6.30 a.m.	29.372	29.104	45.3	42.9	.269	.812	......	7.8	N. 67 W.	1.5	111.5	....	....	[illegible]
7.00 a.m.	29.372	29.101	45.6	43.2	.271	.806	0.81	7.8	N. 67 W.	1.5	117.8	....	....	[illegible]
7.30 a.m.	29.375	29.101	46.0	43.5	.274	.807	......	7.8	N. 70 W.	1.5	88.1	....	....	[illegible]
8.00 a.m.	29.376	29.100	46.5	43.8	.276	.790	0.56	7.8	N. 65 W.	1.4	102.7	....	....	[illegible]
8.30 a.m.	29.379	29.099	47.0	44.2	.279	.784	......	7.9	N. 62 W.	1.5	121.0	....	....	234.
9.00 a.m.	29.379	29.097	47.7	44.9	.282	.769	0.79	7.8	N. 60 W.	1.4	131.0	....	....	213.
9.30 a.m.	29.380	29.095	48.2	45.0	.285	.756	......	7.9	N. 63 W.	1.4	101.2	....	....	241.
10.00 a.m.	29.380	29.092	48.9	45.5	.287	.749	0.71	7.9	N. 51 W.	1.3	147.7	....	....	173.
10.30 a.m.	29.381	29.092	49.5	45.8	.292	.740	......	7.9	N. 55 W.	1.2	133.8	....	....	180.
11.00 a.m.	29.379	29.087	50.1	46.3	.294	.730	0.78	7.9	N. 48 W.	1.2	140.4	....	....	177.
11.30 a.m.	29.374	29.081	50.6	46.6	.293	.719	......	7.9	N. 45 W.	0.9	116.3	....	....	117.
12.00 m ..	29.370	29.074	51.2	47.0	.296	.710	0.64	7.8	N. 49 W.	0.9	103.8	....	....	127.
12.30 p.m.	29.367	29.071	51.5	47.1	.296	.699	......	7.7	N. 45 W.	0.8	117.8	....	....	112.
1.00 p.m.	29.363	29.067	51.9	47.3	.296	.691	0.89	7.5	N. 40 W.	0.8	109.1	....	....	91.
1.30 p.m.	29.359	29.062	52.2	47.6	.297	.685	......	7.5	N. 45 W.	0.6	80.9	....	....	78.
2.00 p.m.	29.356	29.061	52.6	47.6	.296	.677	0.74	7.5	N. 45 W.	0.7	91.6	....	....	93.
2.30 p.m.	29.354	29.058	52.4	47.6	.296	.680	......	7.5	N. 45 W.	0.6	78.6	....	....	65.
3.00 p.m.	29.354	29.059	52.2	47.5	.292	.681	0.73	7.5	N. 22 W.	0.5	100.6	....	....	33.
3.30 p.m.	29.355	29.061	51.8	47.2	.294	.689	......	7.5	N. 42 W.	0.6	86.9	....	....	77.
4.00 p.m.	29.356	29.064	51.3	47.0	.292	.699	0.94	7.5	N. 31 W.	0.6	97.1	....	....	56.
4.30 p.m.	29.358	29.070	50.8	46.5	.288	.705	......	7.5	N. 38 W.	0.6	87.6	....	....	79.
5.00 p.m	29.361	29.076	50.2	46.1	.285	.713	0.55	7.5	N. 40 W.	0.8	109.1	....	....	85.
5.30 p.m.	29,364	29.082	49.7	45.7	.282	.721	......	7.6	N. 26 W.	0.9	140.1	....	....	71.
6.00 p.m.	29.366	29.086	49.1	45.4	.281	.729	0.46	7.6	N. 34 W.	0.7	102.0	....	....	62.
6.30 p.m.	29.367	29.089	48.7	45.1	.279	.736	......	7.3	N. 22 W.	0.5	93.8	....	....	38.
7.00 p.m.	29.370	29.095	48.2	44.8	.276	.742	0.33	7.1	N. 31 W.	0.6	96.4	....	....	67.
7.30 p.m.	29.371	29.096	47.9	44.5	.275	.749	......	7.0	N. 59 W.	0.6	54.0	....	....	93.
8.00 p.m.	29.372	29.100	47.6	44.3	.273	.754	0.27	6.8	N. 67 W.	0.8	62.6	....	....	119.
8.30 p.m.	29.373	29.102	47.4	44.2	.271	.759	......	6.7	N. 50 W.	0.8	85.4	...	....	104.
9.00 p.m.	29.376	29.103	47.0	44.0	.271	.764	0.37	6.6	N. 45 W.	0.7	90.6	....	....	87.
9.30 p.m	29.375	29.106	46.8	43.8	.269	.767	......	6.6	N. 45 W.	0.7	83.8	....	....	87.
10.00 p.m.	29.375	29.107	46.7	43.7	.268	.769	0.51	6.7	N. 37 W.	1.0	143.3	....	....	104.
10.30 p.m.	29.375	29.106	46.5	43.5	.268	.776	......	6.7	N. 40 W.	0.8	115.9	....	....	87.
11.00 p.m.	29.374	29.107	46.3	43.4	.267	.777	0.24	6.7	N. 41 W.	1.0	152.5	....	....	127.
11.30 p.m.	29.374	29.107	46.0	43.2	.266	.780	......	6.7	N. 61 W.	1.8	165.2	....	....	295.
12.00 m ..	29.373	29.108	45.9	43.1	.265	.784	0.56	6.6	N. 29 W.	1.0	170.0	....	....	94.
Mean 7,2,9	29.368	29.088	48.4	44.9	.279	.749	......	7.3	N. 58 W.	0.9	300.0	....	....	436.
Mean of all	29.370	29.092	47.7	44.6	.282	.755	15.55	7.3	N. 52 W.	1.1	6329.7	....	....	7507.

Meteorological observations at Thunder Bay Island, &c.—Continued.

WINTER.

Time of observation.	Pressure reduced to 32° Fahr.		Temp., Fahr.		Vapor.		Amount of rain and melted snow, U. S. inches and decimals.	Amount cloudiness. (10=sky entirely overcast. 0=clear sky.)	Wind.					
	Total U. S. inches and decimals.	Gaseous, U. S. inches and decimals.	Dry bulb.	Wet bulb.	Elasticity, U. S. inches and decimals.	Humidity. Saturation = 1.000.			Observed direction; from whence.	Observed velocity; miles per hour.	Resolution of direction and velocity, in miles per hour.			
											N.	S.	E.	W.
			°	°					°					
0. 30 a.m	29. 333	29. 239	21. 6	19. 7	. 094	. 707	......	7. 8	N. 58 W.	3. 1	291. 1	....	......	479. 0
1. 00 a.m.	29. 332	29. 239	21. 4	19. 5	. 093	. 706	0. 88	7. 8	N. 56 W.	3. 4	337. 2	....	......	503. 6
1. 30 a.m.	29. 322	29. 239	21. 1	19. 2	. 093	. 708	......	7. 7	N. 55 W.	3. 3	306. 7	....	......	479. 1
2. 00 a.m.	29. 331	29. 239	20. 9	19. 1	. 092	. 709	1. 10	7. 2	N. 53 W.	3. 3	359. 3	....	......	477. 5
2. 30 a.m.	29. 330	29. 238	20. 8	18. 9	. 092	. 712	......	7. 9	N. 48 W.	3. 5	409. 0	....	......	473. 0
3. 00 a.m.	29. 330	29. 238	29. 7	18. 8	. 091	. 713	1. 07	7. 9	N. 49 W.	3. 6	439. 8	....	......	498. 9
3. 30 a.m.	29. 328	29. 236	20. 7	18. 8	. 092	. 714	......	7. 9	N. 43 W.	3. 4	436. 5	....	......	415. 5
4. 00 a.m.	29. 327	29. 234	20. 7	19. 0	. 092	. 715	0. 96	8. 0	N. 55 W.	2. 8	297. 8	....	......	409. 7
4. 30 a.m.	29. 326	29. 233	20. 8	19. 0	. 093	. 718	......	8. 2	N. 49 W.	3. 2	376. 6	....	......	432. 7
5. 00 a.m.	29. 326	29. 233	20. 9	19. 1	. 093	. 722	1. 24	8. 2	N. 51 W.	2. 8	319. 7	....	......	401. 8
5. 30 a.m.	29. 327	29. 232	21. 0	19. 3	. 095	. 725	......	8. 3	N. 55 W.	2. 9	300. 7	....	......	434. 8
6. 00 a.m.	29. 327	29. 232	21. 1	19. 3	. 095	. 723	1. 23	8. 4	N. 58 W.	2. 7	274. 2	....	......	414. 2
6. 30 a.m.	29. 328	29. 234	21. 2	19. 4	. 094	. 723	......	8. 5	N. 57 W.	2. 6	253. 5	....	......	397. 2
7. 00 a.m.	29. 330	29. 235	21. 3	19. 5	. 094	. 719	0. 94	8. 3	N. 62 W.	2. 2	186. 7	....	......	338. 9
7. 30 a.m.	29. 332	29. 237	21. 4	19. 7	. 095	. 720	......	8. 5	N. 54 W.	2. 1	214. 4	....	......	309. 7
8. 00 a.m.	29. 335	29. 240	21. 7	19. 9	. 095	. 720	0. 93	8. 6	N. 60 W.	2. 0	181. 3	....	......	308. 7
8. 30 a.m.	29. 339	29. 243	22. 0	20. 1	. 906	. 717	......	8. 6	N. 60 W.	2. 0	174. 9	....	......	315. 5
9. 00 a.m.	29. 342	29. 246	22. 3	20. 4	. 096	. 711	0. 90	8. 7	N. 71 W.	1. 9	104. 0	....	......	319. 1
9. 30 a.m.	29. 342	29. 246	22. 8	20. 7	. 097	. 705	......	8. 3	N. 65 W.	1. 9	145. 5	....	......	303. 5
10. 00 a.m.	29. 342	29. 244	23. 2	21. 2	. 098	. 702	0. 76	8. 8	N. 68 W.	1. 6	114. 4	....	......	280. 7
10. 30 a.m.	29. 341	29. 243	23. 8	21. 6	. 099	. 693	......	8. 7	N. 67 W.	2. 1	148. 2	....	......	339. 5
11. 00 a.m.	29. 337	29. 236	24. 3	21. 9	. 101	. 691	0. 78	8. 7	N. 66 W.	1. 9	155. 2	....	......	329. 5
11. 30 a.m.	29. 334	29. 233	24. 8	22. 5	. 101	. 681	......	8. 8	N. 62 W.	2. 2	177. 1	....	......	344. 4
12 00 m ..	29. 328	29. 226	25. 3	22. 8	. 102	. 676	0. 76	8. 7	N. 63 W.	2. 3	181. 0	....	......	370. 0
12. 30 p.m.	29. 322	29. 218	25. 7	23. 1	. 103	. 674	......	8. 6	N. 63 W.	2. 0	164. 0	....	......	325. 1
1. 00 p.m.	29. 316	29. 213	25. 9	23. 4	. 104	. 667	0. 51	8. 4	N. 66 W.	2. 2	161. 2	....	......	363. 0
1. 30 p.m.	29. 314	29. 209	26. 2	23. 6	. 104	. 663	......	8. 5	N. 69 W.	1. 9	135. 9	....	......	324. 6
2. 00 p.m.	29. 314	29. 209	26. 2	23. 6	. 104	. 662	0. 56	8. 5	N. 66 W.	1. 7	131. 7	....	......	297. 3
2. 30 p.m.	29. 316	29. 213	26. 2	23. 7	. 104	. 665	......	8. 6	N. 59 W.	1. 8	161. 0	....	......	274. 8
3. 00 p.m.	29. 316	29. 213	26. 0	23. 4	. 104	. 665	0. 61	8. 5	N. 61 W.	1. 8	159. 3	....	......	297. 3
3. 30 p.m.	29. 319	29. 216	25. 7	23. 1	. 102	. 671	......	8. 6	N. 63 W.	1. 8	150. 0	....	......	289. 2
4. 00 p.m.	29. 322	29. 220	25. 2	22. 7	. 102	. 678	0. 52	8. 5	N. 60 W.	1. 6	150. 9	....	......	256. 9
4. 30 p.m.	29. 325	29. 225	24. 8	22. 4	. 104	. 682	......	8. 5	N. 60 W.	1. 4	118. 1	....	......	221. 1
5. 00 p.m.	29. 329	29. 229	24. 4	22. 1	. 100	. 685	0. 61	8. 4	N. 58 W.	1. 5	150. 3	....	......	229. 0
5. 30 p.m.	29. 332	29. 233	24. 1	21. 8	. 099	. 684	......	8. 4	N. 59 W.	1. 7	163. 5	....	......	262. 8
6. 00 p.m.	29. 333	29. 235	23. 8	21. 5	. 098	. 691	0. 63	8. 2	N. 50 W.	1. 7	198. 8	....	......	241. 5
6. 30 p.m.	29. 339	29. 241	23. 6	21. 4	. 098	. 693	......	8. 2	N. 55 W.	1. 9	199. 7	....	......	291. 2
7. 00 p.m.	29. 341	29. 244	23. 4	21. 3	. 098	. 697	0. 60	8. 0	N. 55 W.	2. 1	212. 1	....	......	299. 5
7. 30 p.m.	29. 342	29. 244	23. 2	21. 1	. 098	. 695	......	7. 9	N. 57 W.	2. 0	205. 3	....	......	314. 4
8. 00 p.m.	29. 342	29. 244	23. 2	21. 1	. 098	. 699	0. 52	7. 8	N. 58 W.	2. 1	204. 2	....	......	331. 7
8. 30 p.m.	29. 341	29. 243	22. 9	20. 9	. 698	. 701	......	7. 7	N. 38 W.	2. 1	190. 1	....	......	335. 7
9. 00 p,m.	29. 340	29. 243	22. 9	20. 8	. 097	. 703	0. 64	7. 6	N. 61 W.	2. 1	185. 5	....	......	324. 6
9. 30 p.m.	29. 340	29. 243	22. 7	20. 6	. 096	. 703	......	7. 6	N. 62 W.	2. 2	189. 2	....	......	349. 9
10. 00 p.m.	29. 339	29. 243	22. 6	20. 6	. 096	. 704	0. 43	7. 7	N. 62 W.	2. 4	206. 4	....	......	385. 7
10. 30 p.m.	29. 338	29. 242	22. 4	20. 3	. 095	. 703	......	7. 8	N. 59 W.	2. 5	230. 3	....	......	394. 8
11. 00 p.m.	29. 336	29. 242	22. 3	20. 3	. 095	. 704	0. 39	7. 1	N. 59 W.	2. 9	253. 1	....	......	450. 9
11. 30 p.m.	29. 334	29. 239	22. 0	20. 2	. 095	. 705	......	7. 8	N. 63 W.	3. 1	261. 4	....	......	505. 9
12. 00 m ..	29. 333	29. 240	21. 8	19. 8	. 093	. 702	0. 55	7. 9	N. 60 W.	3. 0	279. 0	....	......	470. 1
Mean 7,2,9	29. 328	29. 228	23. 5	21. 3	. 098	. 695	......	8. 1	N. 61 W.	2. 1	503. 9	....	......	960. 8
Mean of all	29. 332	29. 234	23. 0	20. 9	. 097	. 698	18. 12	8. 2	N. 59 W.	2. 3	10699. 8	....	......	17213. 1

Meteorological observations at Thunder Bay Island, &c.—**Continued.**

TWO YEARS.

Time of observation.	Pressure reduced to 32° Fahr.		Temp., Fahr.		Vapor.		Amount of rain and melted snow, U. S. inches and decimals.	Amount cloudiness. (10 = sky entirely overcast, 0 = clear sky.)	Wind.					
	Total, U. S. inches and decimals.	Gaseous, U. S. inches and decimals.	Dry bulb.	Wet bulb.	Elasticity, U. S. inches and decimals.	Humidity. Saturation = 1.000.			Observed direction; from whence.	Observed velocity; miles per hour.	Resolution of direction velocity, in miles hour.			
											N.	S.	E.	W
			°	°					°					
0.30 a.m.	29.356	29.124	40.0	37.4	.231	.759	......	6.4	N. 28 W.	1.9	1267.9	....	......	
1.00 a.m.	29.356	29.125	39.8	37.2	.231	.761	3.22	6.4	N. 35 W.	2.1	1229.7	....	......	
1.30 a.m.	29.355	29.124	39.5	37.0	.230	.765	......	6.3	N. 34 W.	2.2	1318.6	....	......	
2.00 a.m.	29.354	29.125	39.2	36.8	.229	.768	3.58	6.3	N. 36 W.	2.2	1323.7	....	......	
2.30 a.m.	29.354	29.125	39.1	36.7	.229	.772	......	6.6	N. 36 W.	2.4	1410.7	....	......	
3.00 a.m.	29.353	29.125	38.9	36.6	.228	.775	3.38	6.6	N. 36 W.	2.2	1332.4	....	......	
3.30 a.m	29.353	29.124	38.9	36.6	.229	.777	......	6.7	N. 32 W.	2.3	1392.5	....	......	
4.00 a.m.	29.353	29.123	39.0	36.7	.233	.779	3.83	6.8	N. 41 W.	2.0	1069.5	....	......	
4.30 a.m.	29.352	29.121	39.0	36.8	.230	.781	......	7.0	N. 39 W.	2.1	1170.9	....	......	
5.00 a.m.	29.352	29.121	39.1	36.9	.227	.783	3.59	7.0	N. 41 W.	1.9	1045.4	....	......	
5.30 a.m.	29.353	29.120	39.3	37.1	.233	.783	......	7.2	N. 41 W.	2.1	995.1	....	......	
6.00 a.m.	29.354	29.118	39.8	37.4	.236	.781	3.43	7.3	N. 40 W.	1.7	946.1	....	......	
6.30 a.m	29.356	29.118	40.1	37.7	.239	.777	......	7.3	N. 42 W.	1.6	858.6	....	......	
7.00 a.m.	29.358	29.115	40.8	38.2	.242	.767	3.02	7.2	N. 42 W.	1.5	782.9	....	......	
7.30 a.m.	29.359	29.115	41.4	38.7	.245	.762	......	7.4	N. 39 W.	1.5	775.1	....	......	
8.00 a.m.	29.363	29.113	42.1	39.2	.249	.752	2.22	7.3	N. 38 W.	1.3	736.6	....	......	
8.30 a.m.	29.365	29.112	42.7	39.6	.252	.744	......	7.3	N. 38 W.	1.3	737.5	....	......	
9.00 a.m.	29.366	29.112	43.3	40.1	.254	.733	2.12	7.3	N. 38 W.	1.1	631.8	....	......	
9.30 a.m.	29.367	29.111	43.9	40.4	.256	.724	......	7.2	N. 42 W.	1.2	648.5	....	......	
10.00 a.m.	29.367	29.110	44.5	40.9	.257	.714	2.02	7.3	N. 41 W.	1.1	629.9	....	......	
10.30 a.m.	29.367	29.108	45.1	41.2	.259	.702	......	7.3	N. 38 W.	1.1	629.0	....	......	
11.00 a.m.	29.364	29.104	45.6	41.5	.261	.696	2.08	7.3	N. 37 W.	1.0	549.8	....	......	
11.30 a.m.	29.362	29.100	46.1	41.9	.261	.686	......	7.3	N. 32 W.	0.9	594.9	....	......	
12.00 m...	29.359	20.096	46.5	42.1	.262	.678	2.03	7.3	N. 32 W.	0.9	571.5	....	......	
0.30 p.m.	29.354	29.093	46.9	42.3	.261	.670	......	7.3	N. 30 W.	0.8	528.9	....	......	
1.00 p.m.	29.350	29.089	47.1	42.4	.261	.662	2.21	7.2	N. 26 W.	0.9	570.2	....	......	
1.30 p.m.	29.347	29.086	47.3	42.6	.260	.656	......	7.2	N. 23 W.	0.8	494.2	....	......	
2.00 p.m.	29.344	29.084	47.6	42.6	.260	.654	2.33	7.2	N. 16 W.	0.7	504.8	....	......	
2.30 p.m.	99.343	29.083	47.5	42.7	.260	.653	......	7.2	N. 16 W.	0.7	501.3	....	......	
3.00 p.m.	29.341	29.082	47.4	42.5	.258	.653	3.00	7.3	N. 20 W.	0.9	613.3	....	......	
3.30 p.m.	29.342	29.083	47.1	42.3	.258	.658	......	7.3	N. 18 W.	0.9	622.7	....	......	
4.00 p.m.	29.342	29.085	46.7	42.0	.257	.663	3.18	7.2	N. 18 W.	0.9	668.1	....	......	
4.30 p.m.	29.343	29.088	46.2	41.7	.256	.671	......	7.2	N. 18 W.	0.9	629.5	....	......	
5.00 p.m.	29.345	29.092	45.7	41.3	.253	.677	2.24	7.2	N. 21 W.	0.8	605.7	....	......	
5.30 p.m.	29.347	29.096	45.1	40.9	.250	.685	......	7.2	N. 18 W.	0.9	652.3	....	......	
6.00 p.m.	29.348	29.099	44.6	40.5	.248	.692	2.03	7.4	N. 18 W.	0.9	649.2	....	......	
6.30 p.m.	29.349	29.104	44.0	40.2	.246	.699	......	7.1	N. 17 W.	1.0	717.2	....	......	
7.00 p.m.	29.352	29.109	43.5	39.8	.243	.709	1.90	7.1	N. 24 W.	1.2	796.9	....	......	
7.30 p.m.	29.353	29.111	43.0	39.5	.242	.713	......	7.1	N. 21 W.	1.4	923.5	....	......	
8.00 p.m.	29.354	29.114	42.6	39.2	.240	.719	2.13	6.8	N. 26 W.	1.3	900.1	....	......	
8.30 p.m.	29.356	29.117	42.2	39.0	.239	.726	......	6.7	N. 25 W.	1.4	972.8	....	......	
9.00 p.m.	29.357	29.119	41.9	38.8	.238	.732	2.60	6.5	N. 25 W.	1.4	963.3	....	......	
9.30 p.m.	29.358	29.121	41.6	38.5	.236	.736	......	6.4	N. 25 W.	1.4	986.4	....	......	
10.00 p.m.	29.358	29.123	41.3	38.4	.235	.740	2.33	6.4	N. 25 W.	1.7	1083.4	....	......	
10.30 p.m.	29.358	29.123	41.1	38.1	.234	.744	......	6.3	N. 28 W.	1.7	1065.5	....	......	
11.00 p.m.	29.358	29.124	40.8	38.0	.233	.747	1.84	6.1	N. 32 W.	1.9	1133.5	....	......	
11.30 p.m.	29.357	29.123	40.5	37.8	.233	.751	......	6.3	N. 43 W.	2.1	1117.6	....	......	
12.00 m...	29.356	29.124	40.4	37.6	.232	.757	3.02	6.3	N. 34 W.	1.9	1140.3	....	......	
Mean 7,2,9	29.353	29.106	43.4	39.9	.247	.718	......	7.0	N. 31 W.	1.2	2251.0	....	......	
Mean of all	29.354	29.110	42.8	39.4	.244	.725	63.38	7.0	N. 34 W.	1.4	41469.3	....	......	

TABLE L.—*Hourly records of the direction and relative velocity of the wind at Milwaukee, Wisconsin, taken from the sheets of the anemograph kept by observer J. A. Lapham.*

Time of observation.	APRIL, 1861.					
	1st.	2d.	3d.	4th.	5th.	6th.
	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.
A. M.						
1	SE. by E...5.0	West.......0.6	W. by S....0.8	E. by S.....2.9	E. by N....3.5	E.NE.......2.4
2	E. by S.....5.0	West.......0.5	N.NW......0.9	E.SE......4.0	East.......2.9	NE. by E...3.1
3	E. by S.....2.6	West.......0.2	N.NW......0.3	E.SE......4.0	E. by N ... 3.0	E.NE......3.6
4	NE.........3.5	W. by N....0.4	North......1.0	E.SE......3.7	E. by N....3.1	E.NE......3.3
5	N. by E.....5.5	W. by N....0.6	N. by E.....1.2	SE. by E...4.0	E.NE......3.0	E.NE......3.2
6	N. by E.....6.2	South......0.2	N. by W....0.2	SE. by E...3.5	E.NE......3.0	E. by N....2.7
7	North......5.0	W. by N....0.5	N.NE.......1.0	E.SE......4.1	E.NE......3.2	East........2.4
8	North......5.0	NW........0.5	NE. by N...1.4	E. by S.....5.0	E.NE......3.1	E.SE.......2.0
9	North......3.7	....	NE.........1.5	East........4.7	E.NE......3.2	E.SE.......2.2
10	North......2.7	....	NE. by N...2.5	East........4.0	E.NE......3.0	SE. by E...3.7
11	NW. by N..3.0	....	NE.........2.5	E. by N....3.7	E.NE......3.2	E.SE.......4.0
12	NW.........3.5	....	NE. by E...2.5	E. by N....3.1	E.NE......2.8	E.SE.......3.3
P. M.						
1	W. NW....3.0	....	E.NE...... 2.8	E.NE......3.2	E.NE......2.6	SE. by E...4.2
2	NW. by W..3.0	....	E.NE......2.7	E.NE......3.3	E.NE......3.4	SE. by E...5.5
3	W. NW.....2.5	....	NE.........3.6	E.NE......3.0	E.NE......3.2	SE.........3.9
4	West......2.5	....	NE. by N...3.2	E.NE......3.0	E.NE......2.7	SE.........4.8
5	W. NW....0.5	....	NE. by N...3.8	NE. by E...3.5	E. by N....2.0	SE.........5.1
6	....	....	N.NE.......3.0	E.NE.......3.5	E.NE......3.1	SE.........6.2
7	SW.........0.1	....	N. by E....1.0	E. by N....1.9	E.NE......3.5	SE.........6.8
8	SW. by S...0.1	....	N.NE.......2.0	East........1.9	E.NE......3.0	SE. by S...4.1
9	SW.........0.1	S. by W....0.9	N. by E....3.5	E. by N....1.3	E.NE......2.5	SE.........5.5
10	W. by S....0.2	SW. by S...0.8	N.NE.......3.9	East........2.7	E.NE......2.6	E.SE.......4.9
11	W. by S....1.2	SW.........0.7	N.NE.......3.4	East........3.0	East........2.9	SE.........5.1
12	West.......0.8	S.SW.......0.5	E. by S.....2.2	E. by N....3.0	East........2.7	SE.........5.0
	7th.	8th.	9th.	10th.	11th.	12th.
A. M.						
1	South.......4.2	SE. by E...4.0	NE. by N...4.0	E.NE.......3.8	NE. by N...1.1	N. by W....0.4
2	S. SE.......3.4	E.SE.......3.8	NE. by N...4.1	E.NE.......3.3	NE.........0.7	....
3	S. SE.......3.5	E.SE.......3.2	NE. by N...4.2	NE.........3.5	East........2.0	West.......0.4
4	SE. by S....2.0	E. by S.....3.3	NE.........3.0	E.NE......3.3	East........2.2	....
5	SE. by S....1.5	East........2.0	N.NE.......2.8	NE.........3.2	E.SE.......2.1	....
6	....	E. by S.....3.2	NE. by N...2.9	NE. by E...3.8	E.SE.......1.4	....
7	....	E.SE.......4.2	N.NE.......3.1	NE. by E...4.1	E.SE.......1.0	South......0.1
8	....	SE. by E...3.4	N.NE.......2.3	E.NE......3.6	E.SE.......0.8	S. by W....0.1
9	....	E.SE.......1.7	N. by E....3.1	E.NE......3.1	East........0.7	....
10	E. by S.....0.4	E.SE.......2.1	North......3.9	E. by N....2.7	E. by N....1.0	....
11	SE.........0.3	SE. by E...1.6	N. by E....4.1	E. by S.....2.1	E.NE......1.5	....
12	SE.........2.2	E.SE.......1.4	N.NE.......3.9	E. by N....1.9	NE.........2.8	....
P. M.						
1	SE.........3.0	E.SE.......1.4	N. by E....3.3	NE. by N...3.0	N.NE.......3.0	....
2	SE.........3.0	East........1.5	N.NE.......4.0	N.NE.......2.3	N.NE.......4.2	....
3	SE. by E...1.5	E. by S.....0.5	N.NE.......4.4	N. by E....3.6	N. by E....4.1	....
4	E. NE.......0.3	....	N. by E....3.4	N. by E....3.8	North......4.1	....
5	NE. by E...1.0	....	N. by E....4.0	N. by E....3.5	....	....
6	NE.........1.1	....	N. by E....4.0	N. by E....4.0	....	NE. by E......
7	NE. by E...1.5	N. by E....4.3	N. by E....3.9	N.NE.......3.8	N. by E....1.3	N.NE.......1.3
8	E.NE.......4.0	N. by E....3.9	N. by E....4.0	N. by E....4.1	N. by W....1.2	N. by E....1.5
9	East........3.0	N.NE.......4.3	N.NE.......2.9	N.NE.......2.5	North......1.0	....
10	E. by S.....4.3	N.NE.......4.7	N.NE.......2.8	NW. by N..0.5	North......1.2	....
11	East........3.9	N.NE.......4.2	NE.........3.7	North......0.5	N. by W....0.8	....
12	E.SE.......3.3	NE. by N...4.2	NE.........3.8	N. by E....0.5	North......1.1	....
	13th.	14th.	15th.	16th.	17th.	18th.
A. M.						
1	....	E. by N....0.6	SE.........2.1	NE. by N...4.1	N.NW......1.4	SW.........1.3
2	....	North......0.4	NE. by E...1.5	NE. by N...3.9	N.NW......1.2	W. by S....2.2
3	....	NW. by N..0.2	NE.........1.9	NE. by N...4.0	NW.........1.3	W. by S....2.2
4	....	NW. by W .0.9	N.NE.......2.8	NE. by N...4.5	NW.........1.1	W. by S....1.6
5	....	N. by W....1.6	N.NE.......2.3	N.NE.......3.8	NW. by N..1.1	NW.........2.8

Hourly direction and relative velocity of the wind, &c.—Continued.

Time of observation.	APRIL, 1861.					
	13th.	14th.	15th.	16th.	17th.	18th.
	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.
A. M.						
6	....	North 1.5	N.NE 4.4	N.NE 4.2	NW. by N .. 0.9	W.NW 2.5
7	NW 0.2	North 2.0	N.NE 4.5	N.NE 4.5	North 0.2	W.NW 3.5
8	NW 0.3	North 2.2	N.NE 4.9	N.NE 5.0	....	W. by N 3.9
9	NW 0.7	NE. by N ... 1.5	N.NE 4.6	N.NE 5.3	E. by S 0.2	W.NW 4.7
10	NW. by N .. 1.7	East 1.5	N.NE 5.1	N.NE 5.7	E.SE 1.1	W. by N 5.0
11	NW. by N .. 3.1	E. by S 2.1	N.NE 4.8	N.NE 5.5	E.SE 3.3	W.NW 5.2
12	NW 3.2	East 2.5	N.NE 5.0	N.NE 5.6	SE 3.7	NW. by N .. 4.8
P. M.						
1	NW. by N .. 3.6	SE. by E ... 3.1	NE. by N ... 4.7	N.NE 5.5	SE 4.2	North 4.1
2	North 2.8	SE 3.1	NE. by N ... 4.2	N.NE 5.1	SE. by S ... 3.5	North 4.5
3	E.NE 2.3	SE 3.4	NE 4.0	N.NE 5.0	SE. by S ... 2.3	North 4.8
4	E. by N 1.4	SE 3.4	NE 3.4	N.NE 5.2	S.SE 1.0	N. by E 5.8
5	East 0.5	SE 3.5	NE 3.9	N.NE 5.0	SE 1.1	North 3.6
6	E. by S 0.6	SE. by S ... 3.1	NE. by N ... 3.9	N. by E 3.6	SE 1.5	North 3.0
7	E. by S 0.5	SE 1.9	NE. by N ... 3.9	N. by E 2.5	SE. by S ... 4.5	N. by W 2.6
8	SE 0.7	South 1.4	NE 3.4	NW 1.0	SE. by S ... 5.2	N. by W 1.6
9	East 0.8	South 1.3	NE. by N ... 4.0	N. by W 0.5	SE. by S ... 5.8	North 2.5
10	NE. by E ... 2.4	North 1.0	NE. by N ... 4.0	N.NW 1.1	S.SE 5.0	North 3.1
11	E.NE 2.5	E.NE 0.9	NE. by N ... 4.5	NW. by N .. 1.3	S. by E 2.2	N.NW 2.8
12	NE 1.7	E.NE 2.3	NE. by N ... 4.1	N. by W 1.1	South 1.3	NW. by N .. 3.0

	19th.	20th.	21st.	22d.	23d.	24th.
A. M.						
1	NW 3.0	S.SW 3.0	....	SW 3.4	N.NE 4.1	SW 4.7
2	NW 3.0	S.SW 2.3	South 0.1	SW 4.3	N. by E 4.5	SW. by W .. 3.8
3	N.NW 2.5	S.SW 2.9	....	SW 3.3	N. by E 3.1	W.SW 3.9
4	N.NW 2.5	SW. by S ... 3.5	....	SW. by W .. 3.9	N.NE 5.0	W. by S 3.9
5	N.NW 2.4	SW 3.5	....	SW. by W .. 3.1	N.NE 3.5	W. by S 4.0
6	N.NW 2.3	SW. by S ... 3.1	SE 0.4	SW. by W .. 3.0	N. by E 3.0	W.SW 4.3
7	N.NW 2.2	SW. by S ... 4.6	SE 1.5	SW. by W .. 3.7	N. by E 3.4	W.SW 5.1
8	North 1.7	SW. by S ... 5.0	SE 1.0	SW. by W .. 4.5	N. by E 3.3	W. by S 5.0
9	North 1.1	SW 5.1	E. by S 0.8	SW 5.5	N. by E 3.0	W. by S 6.6
10	E.NE 2.0	SW 5.5	SE. by S ... 1.3	West 4.9	N. by E 2.1	W. by S 6.3
11	East 2.1	SW 5.2	SE 2.2	S.SW 3.8	N. by E 2.7	West 6.4
12	E.SE 2.0	SW 5.6	SE 3.8	S.SW 4.7	N. by E 3.2	West 5.7
P. M.						
1	E.SE 2.0	SW 5.0	SE 3.7	West 4.5	N.NE 3.0	West 5.7
2	SE 2.5	SW. by S ... 4.5	SE 3.5	West 3.7	N. by W 1.3	West 6.3
3	SE 2.6	SW. by S ... 4.0	SE. by S ... 3.5	West by N .. 2.6	N. by E 0.7	W. by N 6.7
4	SE. by S ... 3.0	SW 3.2	South 3.6	W.NW 2.1	NE. by N ... 0.1	West 5.5
5	SE. by S ... 3.7	SW. by W .. 3.8	South 3.7	NW 1.7	....	W. by N 4.7
6	S.SE 2.9	S.SW 2.5	S. by W 2.7	NW 0.4	W. by S 1.5	NW 2.2
7	S. by E 1.2	South 1.4	E.SE 0.7	....	West 4.1	W.NW 2.2
8	S. by W 1.3	South 1.0	S. by E 1.0	....	West 2.6	W. by N 2.0
9	S.SW 2.0	South 0.6	E.SE 0.8	....	W.SW 2.8	W.NW 2.8
10	S.SW 2.0	S. by W 0.8	South 1.2	North 0.2	W. by S 3.7	NW 0.9
11	SW. by S ... 1.5	South 0.5	S.SW 2.5	North 1.0	W.SW 3.0	NW 0.1
12	SW. by S ... 2.0	....	SW. by S ... 3.0	North 0.6	SW. by W .. 3.5	....

	25th.	26th.	27th.	28th.	29th.	30th.
A. M.						
1	....	SE 2.6	S.SW 4.5	NW. by W .. 1.1	W. by S 2.1	NW. by W .. 0.1
2	....	SE 2.1	W.SW 2.8	W.NW 0.8	West 0.8	....
3	....	SE. by S ... 1.3	S.SW 0.1	W. by N 1.3	W. by N 0.3	....
4	....	SE. by S ... 0.8	SW 0.1	W.NW 1.8	W.NW 0.7	....
5	....	S.SE 1.3	W.SW 1.6	W.NW 0.5	W.NW 0.5	....
6	....	SE. by S ... 1.2	W.NW 3.2	NW. by W .. 0.1	....	....
7	....	SE. by S ... 0.2	NW 2.6	West 0.4	West 0.1	....
8	SW 0.2	NE. by E ... 0.1	NW. by N .. 2.8	W.SW 1.5	W.NW 0.6	W.NW 0.2
9	SW 1.3	E. by N 0.2	NW 2.7	W.SW 2.2	W.NW 2.7	West 0.8
10	E.SE 0.2	E.NE 0.3	NW. by N .. 2.2	S.SW 3.0	West 1.2	W. by N 1.0
11	SE. by E ... 0.8	E.NE 0.6	NW. by N .. 4.2	NW 2.8	W.NW 2.8	W. by N 3.0
12	SE 1.6	SE 1.9	NW 2.9	SW. by S ... 2.9	W. by N 2.1	W.NW 4.7

Hourly direction and relative velocity of the wind, &c.—Continued.

Time of observation.	APRIL, 1861.					
	25th.	26th.	27th.	28th.	29th.	30th.
	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and re ative velocity
P. M.						
1	SE 3.1	SE 4.3	N.NW 2.2	S.SW 2.8	W. by S 3.5	West ......4.
2	SE 4.3	SE. by E ...4.6	NW. by N ..2.2	SW 4.5	West 3.1	NW 5.0
3	SE. by S ...4.0	SE. by E ...3.6	NW 2.6	SW 4.4	W. by S 3.0	NW. by W ..5.4
4	SE 3.6	South 5.0	NW 1.9	SW. by S ...3.5	West 2.1	W.NW 5.8
5	SE. by S ...3.2	South 3.7	NW. by N ..0.4	S.SW 2.6	West 3.0	NW. by W .5.1
6	SE 2.6	South 2.2	....	South 1.6	W. by S 0.6	NW 4.9
7	SE. by E ...1.9	South 2.1	....	SE 0.6	W. by N 0.3	NW 4.1
8	SE. by S ...2.0	SE 1.3	....	South 1.7	....	North 2.0
9	S.SE 2.6	South 2.7	....	South 2.4	W. by N 0.4	North 1.0
10	SE. by S ...2.7	South 4.0	W. by N 0.1	S. by E 3.5	West 0.2	N. by E 0.9
11	SE 2.5	South 4.0	W.NW 0.6	South 3.0	W. by N 0.4	North 0.1
12	SE 2.6	S. by W 4.9	NW 1.0	SW 4.0	W.NW 0.1	North 0.4

Time of observation.	MAY, 1861.					
	1st.	2d.	3d.	4th.	5th.	6th.
A. M.						
1	North 2.1	....	South 0.1	NW. by N ..0.8	SE 2.9	SW 6.8
2	N. by W 1.4	....	....	N.NW 1.0	SE 3.4	SW. by W ..7.4
3	North 0.5	....	N.NE 0.1	NE. by E ...0.6	SE 3.7	SW. by W ..7.1
4	NE. by N ...0.6	....	N.NE 1.4	NE. by E ...0.8	SE 4.0	SW 7.4
5	North 0.4	....	NE 2.2	E.SE 1.9	SE 4.6	SW 7.6
6	....	....	NE. by E ...2.0	E.SE 1.1	SE. by E ...4.7	SW. by W ..7.6
7	N.NW 0.9	SE 0.3	E. by N 2.0	SE. by E ...1.9	SE. by E ...3.9	SW 9.0
8	N.NW 0.3	SE 1.2	NE 2.2	SE 2.8	SE. by E ...3.6	SW ....
9	NE. by N ...1.3	SE 2.7	NE 2.8	SE 3.4	SE. by E ...4.5	SW ....
10	NE 3.5	SE 3.3	NE. by N ...3.3	SE. by E ...3.5	E.SE 2.7	SW ....
11	NE 2.9	SE 4.7	N.NE 4.0	SE. by E ...3.7	E.SE 3.1	SW ....
12	NE 3.0	SE 5.8	N.NE 5.6	E.SE 3.2	E. by S 4.8	SW ....
P. M.						
1	....	SE 5.9	N.NE 6.6	E.SE 3.1	SE 4.9	SW ....
2	....	SE 4.1	N.NE 6.6	SE. by E ...3.0	SE 6.0	SW. by W ....
3	....	SE 3.8	N.NE 6.6	SE. by E ...2.0	SE 6.4	SW ....
4	....	SE. by E ...0.3	N.NE 6.2	E.SE 1.5	SE 7.6	West ....
5	....	....	N.NE 5.5	E. by S 1.2	SE. by S ...6.0	W. by S ....
6	N.NE 0.5	SE 1.5	N. by E 4.0	NE. by E ...0.8	SE 4.6	West ....
7	....	East 0.5	N. by E 3.5	NE 0.1	S. by W 3.1	West ....
8	....	SE 2.2	N.NE 3.2	NE. by E ...1.0	S. by W 2.5	W. by S ....
9	....	SE 1.8	N. by E 4.0	NE. by E ...1.3	S. by E 3.0	W.SW ....
10	....	SE 0.9	N.NE 3.5	NE 0.4	SW 4.8	W.SW ....
11	....	SE. by E ...0.1	N. by E 3.0	SE. by E ...3.7	SW 6.5	W.SW ....
12	....	....	North 1.8	SE. by E ...5.1	SW 6.4	W.SW ....

Time of observation.	7th.	8th.	9th.	10th.	11th.	12th.
A. M.						
1	W.SW	NW. by N	SW	SE. by E	West	NE. by N ....
2	W.NW	NW	W. by S	E.SE	W. by N	NE. by N ....
3	W.SW	NW	W. by N	SE	West	NE ....
4	W.SW	NW	W.NW	SE	West	NE. by N ....
5	W.SW	NW. by W	W. by N	W.NW	West	N.NE ....
6	W. by N	NW	W. by N	E.NE	West	NE ....
7	W.NW	NW	W.NW	W. by S	W.SW	NE ....
8	W.NW	NW	West	W.SW	West	NE ....
9	W. by N	NW	West	West	W. by N	NE ....
10	W.NW	NW	....	W. by N	W. by N	NE. by E ....
11	W. by N	E.NE	....	W. by N	W. by N	E.NE ....
12	W. by N	E.SE	....	West	West	E. by N ....
P. M.						
1	West	SE. by E	....	W. by N	W.NW	E.NE ....
2	West	SE. by E	....	West	W.NW	NE. by E ....
3	West	SE	....	W. by S	W. by N	NE ....
4	W.NW	SE	E. by N	West	NW. by W	N.NE ....
5	W. by N	SE	E.NE	West	NW	N. by E ....

Hourly direction and relative velocity of the wind, &c.—Continued.

Time of observation.	MAY, 1861.					
	7th.	8th.	9th.	10th.	11th.	12th.
	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.
P. M.						
6	NW. by W	SE. by E	SE	West	NW. by W	N.NE
7	NW. by W	SE. by E	SE. by S	W. by N	NW	N.NE
8	NW	S.SE	SE. by S	West	NW	N.NE
9	N.NW	South	SE	West	NW	N. by E
10	N. by E	SW	E. by S	West	W.NW	N. by E
11	NW. by W	SW	S. by E	West	NW. by W	N. by E
12	NW	S.SW	SE	W. by N	N. by E	N.NE

Time of observation.	13th.	14th.	15th.	16th.	17th.	18th.
A. M.						
1	N. by E	NW. by W	W.SW	NW	NE. by N	E.NE
2	N.NE	NW	W. by S	NW	NE	East
3	NE	NW. by W	NW. by W	NW. by N	NE. by E	East
4	E. by N	W.NW	NW	NW	E.NE	E. by N
5	E. by S	NW. by W	W. by S	NW	E.NE	E.NE
6	E. by S	NW. by W	W. by S	NW	E. by N	E.NE
7	E.SE	W.NW	West	North	East	E. by N
8	SE. by E	W.NW	SW. by W	N. by W	SE	E. by N
9	SE. by E	NW. by W	SW. by W	E. by S	E.SE	East
10	SE	W.NW	SW	SE. by E	SE. by E	East
11	East	W.NW	W. SW	SE	SE. by E	E. by N
12	N. by E	NW. by W	W. by S	SE	East	E. by N
P. M.						
1	N.NE	W.NW	West	SE	E. by N	E.NE
2	N. by E	W. by N	West	SE	E.NE	NE. by E
3	West	W. by N	W. by N	SE	E.NE	N.NE
4	W. by N	West	W. by N	SE	NE	N. by E
5		SW. by W	West	SE. by E	NE	N. by E
6		W.SW	W. by N	SE. by E	NE. by N	NE
7		SW	NW	E.SE	NE	NE
8	West	SW	W.NW	E. by S	NE	E.NE
9	W. by N	SW. by W	W.NW	E.SE	NE	East
10	W.NW	SW	NW. by W	East	NE	E.SE
11	W.NW	W. by N	NW	E. by N	NE	SE. by E
12	W.NW	W. by S	NW. by N	NE	E.NE	E. SE

Time of observation.	19th.	20th.	21st.	22d.	23d.	24th.
A. M.						
1	SE. by E	N.NE	N.NE	NW	SW. by W	W.SW
2	SE	N.NE	N. by E	N.NW	SE. by E	SW. by W
3	E.SE	N.NE	N. by E	NW	SE	W.SW
4	East	N.NE	North	N.NW	SE	W. by S
5	E. by N	N.NE	North	NW	SE. by S	W. by S
6	East	N.NE	N. by W	N.NW	SE	W.SW
7	E. by S	N.NE	N. by E	NE	South	W. by S
8	E. by S	N.NE	N.NE	East	S. by W	West
9	E. by S	N.NE	NE. by N	East	S. by W	W. by N
10	E.SE	N.NE	NE	E.SE	S.SW	SW. by W
11	SE. by E	N.NE	NE	SE	S.SW	SW
12	E.NE	N.NE	NE	E.SE	S. by W	SW
P. M.						
1	NE	N.NE	NE	SE. by E	S.SW	East
2	N.NE	N.NE	NE	SE. by E	S.SW	SW
3	NE. by N	N.NE	E.SE	SE	SE	SW
4	NE	N.NE	E. by N	SE	East	SW. by S
5	NE. by N	N. by E	NE	SE	SE	SW. by S
6	N.NE	N. by E	NE	SE	E.SE	SW
7	N.NE	N.NE	N.NE	SE	East	SW. by S
8	N.NE	N. by E	NW	SE. by S	E.SE	W. by N
9	N.NE	N. by E	N.NW	SE. by E	East	W. by S
10	N. by E	N.NE	W.NW	SE	SW. by W	West
11	N.NE	N.NE	NW	South	SW	West
12	N.NE	N.NE	NW	S.SE	SW	W.NW

Hourly direction and relative velocity of the wind, &c.—Continued.

Time of observation.	MAY, 1861.	JUNE, 1861.				
	25th.	3d.	4th.	5th.	6th.	7th.
	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.
A. M.						
1	NW		N. by E 3.7	N. NE 1.3		
2	NE. by N		North 3.4	N. NE 0.8		
3	NE. by N		N. by E	N. NE 1.5		
4	N.NE		North	N. NE 2.2		
5	East		North	N. NE 1.5		
6	N. by W		North	N. NE 1.2		North 0.8
7	West		N. by E 3.8	N. NE 1.7		N. by E 1.8
8	South		N. NE 3.1	N. NE 2.8	NE 1.6	N. NE 1.3
9	S. by E		N. NE 1.3	NE. by N 3.3	NE. by N 1.7	NE. by N 1.6
10	East		N. NE 1.0	NE 2.0	N. NE 2.1	N. NE 2.8
11			N. NE 1.5	N. NE 2.0	NE 2.0	NE 1.9
12			N. NE 1.9	NE 2.1	NE 1.2	NE 1.7
P. M.						
1			N. by E 2.3	NE 1.1	E. SE 1.2	NE 2.1
2			N. by E 2.8	NE 1.3	SE. by E 0.8	NE. by N 2.7
3			N. by E 2.7	E. NE 2.1	SE 0.6	N. NE 2.8
4			N. NE 2.2	NE. by E 1.1	E. by S 0.8	N. NE 2.5
5			N. NE 3.1	N. NE 1.9	N. NE 2.1	N. by E 1.8
6		W. by S 0.3	N. NE 2.3	N. by E 1.1	N. NE 1.7	N. by E 1.8
7		W. by S 0.1	N. NE 2.5	N. NE 0.9	N. by E 1.0	N. NE 1.3
8		W. by S 1.0	N. NE 1.7		North 0.3	N. NE 1.6
9		NW 1.8	N. NE 1.6			North 1.0
10		N. NE 1.7	NE. by N 0.5		N. by E 0.2	N. by E 0.8
11		N. NE 1.3	N. NE 1.5		N. NE 0.8	N. by E 0.3
12		N. by E 3.0	N. NE 1.6		N. by E 0.7	N. by E 0.9

Time of observation.	8th.	9th.	10th.	11th.	12th.	13th.
A. M.						
1	N. by E 0.2			S. SW 0.1	NW 1.1	N. NE 2.2
2		NW. by N 0.1		SW. by S 0.3	N. NW 1.0	N. NE 1.7
3				SW 0.1		N. NE 1.9
4	N. NW 0.1			SW 0.1		N. NE 1.1
5	N. NE 0.4			S. SW 0.3	NW 0.5	N. NE 1.1
6	N. NE 1.0			SW 0.5	NW 0.5	N. NE 1.3
7	NE 1.0			SW. by W 2.0	NW 0.8	NE. by N 0.9
8	NE. by E 1.0		SE 0.9	SW. by W 2.5	N. NE 0.9	NE. by E 0.3
9	East 1.0	NE. by N 0.2	SE 0.1	SW. by W 2.6	E. by S 1.3	SE. by E 0.2
10	NE 1.0	NE. by N 0.5	SE 0.5	W. SW 3.8	E.SE 1.3	SE. by E 1.0
11	NE 1.5	N. NE 0.8	SE. by E 0.8	W. SW 3.2	SE 1.2	SE 0.6
12	NE. by E 1.5	N. NE 1.0	E. SE 1.2	W. by S 3.3	SE 1.1	SE. by E 1.0
P. M.						
1	NE 1.0	N. by E 1.0	E. SE 2.2	W.NW 2.4	SE 1.8	SE. by E 1.0
2	NE 1.0	E. SE 0.5	SE 2.8	W. SW 2.0	SE 1.0	SE 0.8
3	NE 1.1	E. SE 0.5	SE 3.1	W. SW 2.4	W. NW 3.0	SE 0.8
4	NE. by N 1.1	SE. by E 0.5	SE 2.2	W. by S 3.3	SE 1.0	SE 0.7
5	NE. by N 1.5	E. by S 0.1	SE 2.0	SW. by W 1.7	SE 1.5	SE 0.5
6	NE. by N 1.3	SE 0.2	SE 1.1	W. SW 1.6	SE 0.8	SE 0.5
7	N. NE 0.8		SE 0.4	West 2.2	SE. by S 0.1	East 0.5
8	N. by E 0.8			W. by S 0.7		E. SE 0.4
9	N. by E 0.5			W. S. W 0.5		SE 0.1
10	N. by E 0.2	SE 0.2		W. SW 0.7	N. by E 2.7	
11	N. NW 0.1			West 1.4	N. by E 6.3	
12				W. by N 1.6	N. NE 3.6	SE 0.3

Time of observation.	14th.	15th.	16th.	17th.	18th.	19th.
A. M.						
1		SW 1.4	N.NW 2.9	North 1.7	SW 0.1	
2	SW. by S 0.2	SW 1.5	N.NW 2.9	N. by E 0.9	S.SW 0.3	
3	S.SW 0.1	SW 0.7	N.NW 3.0	North 0.5	SW. by S 0.2	
4	S.SW 0.1	SW 0.8	N.NE 3.4	NW 0.2	SW 0.1	S.SW 0.1
5	South 0.2	SW 1.0	N. by E 2.9	N.NW 0.1	SW 0.2	South 0.3
6	South 0.1	SW. by W 3.0	N. by E 3.0	N. by E 0.7	SW 1.1	S. by W 0.2
7	S. by W 2.2	SW 3.7	N. by E 4.5	N.NE 2.1	SW 1.0	SW. by S 0.8
8	S.SW 3.5	SW 5.7	N.NE 4.9	NE. by N 1.5	SW 1.9	SW. by S 0.5
9	SW. by S 4.0	SW. by W 7.0	N.NE 6.5	NE 0.9	SW 2.1	South 0.5

Hourly direction and relative velocity of the wind, &c.—**Continued.**

Time of observation.	JUNE, 1861.					
	14th.	15th.	16th.	17th.	18th.	19th.
	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.
A. M.						
10	S.SW 4.5	W.SW. 8.0	N.NE 6.6	E. by S..... 1.0	SW 2.4	SE 0.5
11	SW. by S .. 4.9	W.SW. 8.5	N.NE 6.5	E.SE........ 1.1	SW.. .... 1.6	SE 1.3
12	SW 5.4	W.SW. 9.2	N.NE 5.7	SE. by E. .. 1.4	SW 1.4	SW. by S... 1.1
P. M.						
1	SW. by S .. 5.5	W.SW. 9.1	N.NE 5.8	E.SE. 1.6	SW 1.0	SE. by E. .. 1.0
2	SW.. ...... 5.4	SW. by W.. 6.2	N.NE 4.7	E.SE. 1.5	SE. 1.1	S. by E..... 1.5
3	SW. by S .. 5.7	SW. by W.. 6.2	N.NE 4.2	E.SE. 1.1	SW 1.5	SE. 1.0
4	SW. by S .. 5.8	W.SW. 5.4	N.NE 4.0	SE. 1.7	SW.. ...... 1.5	North 1.0
5	S.SW 6.3	W.SW. 5.0	N. by E 3.5	SE. 1.2	SW. by S. .. 1.3	SW.. .... 1.2
6	SW. by S .. 5.4	NW. by W.. 6.3	N. by E 2.9	SE. 1.2	SW. by S ... 0.6	S.SW 0.3
7	SW. by S .. 4.4	W.NW. 5.9	N. by E 2.5	SE.. .... 0.7	S.SW 0.2	SW. by W.. 1.0
8	SW. by S .. 3.6	W. by N.... 5.1	North 2.0	South 0.3	....	SW 0.2
9	SW. by S .. 4.0	West. 4.0	North 1.9	South 0.3	S. by E..... 0.1	S.SW 0.1
10	SW 4.4	W.NW. 3.5	North 1.9	S. by W.... 0.1	....	....
11	SW.. ...... 5.4	NW 2.1	North 2.1	S.SW 0.3	....	....
12	SW. by W.. 2.1	NW. by N .. 4.0	North 2.4	S.SW 0.3	....	S.SE 0.2

Time of observation.	20th.	21st.	22d.	23d.	24th.	25th.
A. M.						
1	N.NE 1.7	West. 2.2	W.SW. 0.7	SW. by W.. 0.1	....	SW. by S. .....
2	N.NE 1.9	W.NW. 1.3	W.SW 1.0	....	....	SW ....
3	N.NE 1.1	W.NW. 0.1	W.NW. 2.3	....	....	SW ....
4	N. by E 0.7	NW. 1.0	NW. by W.. 1.1	S.SW 0.1	....	South ....
5	N.NE 0.1	W.NW. 3.1	NW. 0.8	N.NE 3.5	....	SE. 0.2
6	NE. by E... 0.8	NW 3.4	NW. 1.2	N. by E 2.1	E. by N..... 0.1	South 1.2
7	NE. 0.5	N.NW. 2.4	N.NW. 1.2	N. by E 1.9	East. 0.1	SW. by S... 1.5
8	NE. by E... 0.4	N.NW. 1.7	N.NE 2.0	N.NE 2.0	....	S.SW 2.3
9	NE. 0.6	N. by E 1.5	N.NE 2.3	N.NE 2.9	SE. 0.3	SW. by S... 2.5
10	S.SE. 0.5	NE. by E... 1.7	NE. 1.3	N.NE 3.0	SE 0.5	S.SW 2.2
11	SE. 1.1	East. 1.0	E.SE. 1.2	NE. by N... 2.5	SE. 0.7	....
12	NE. by E. .. 1.9	NE. 0.6	E. by S..... 1.0	N.NE 3.2	E.SE. 0.8	....
P. M.						
1	E.NE 2.0	NE. 0.5	SE. 0.9	N.NE 3.1	E.SE. 0.9	....
2	E.SE. 0.8	NE. 0.5	SE. 0.7	NE. by N... 4.0	SE. by E.... 1.3	SE. 3.0
3	SE. 1.7	SW. by W.. 1.6	SE. 0.8	N.NE 3.5	SE. by E.... 1.6	SE. 2.4
4	SE. 1.6	W.SW. 1.8	SE. 0.6	N.NE 3.0	SE. 1.0	SE. 1.7
5	SE	SW. by W.. 1.9	W.SW. 1.7	N.NE 3.0	SE. by E.... 1.5	SE. 1.0
6	SE	W.SW. 0.6	East. 0.1	N.NE 3.0	SE. by E.... 1.3	North 1.5
7	SE	SW. 0.1	....	N.NE 2.5	SE. 0.8	SE. by S ... 1.6
8	....	SW. 0.2	....	N. by E 1.0	SE 0.1	SW 0.6
9	....	SW 0.2	....	N.NE 0.5	....	SW. by S... 1.2
10	....	....	....	North 0.5	....	SW. by W . 1.2
11	SW. by W.. 0.8	SW 0.1	W.SW. 0.3	....	SE. by E.... 0.1	W. by S 2.1
12	SW. by W.. 1.6	SW. by W.. 0.3	W.SW 0.8	....	SW. by S... 0.8	West. 2.6

Time of observation.	26th.	27th.	28th.	29th.	30th.	JULY 1st.
A. M.						
1	W. by S 2.4	W. by S 0.4	W.SW. 0.9	....	W.SW. 0.2	N. by E 3.4
2	West. 2.9	W.SW. 1.0	W.SW. 0.8	....	W. by S 0.4	N. by E 4.1
3	West 2.0	W. by S 0.8	W.SW. 0.7	....	West. 0.4	North.. .... 2.4
4	West 1.6	W. by S 0.2	W.NW. 1.4	....	W. by S 1.8	North.. .... 1.1
5	W.SW. ... 0.7	W. by S 0.1	NW. by W . 1.1	....	W.NW. 1.1	N.NW 0.7
6	W.SW. 1.9	West 0.4	NW 1.2	....	NW 1.7	....
7	West 2.4	West 0.2	NW 1.0	....	NW. by N .. 2.3	North 4.4
8	NW. by N .. 2.2	North 0.4	NW. 0.8	E. by S..... 0.2	NW. by W . 1.7	N. by E 4.8
9	West 3.0	North 0.2	East. 0.8	SE. 0.7	NW. 2.0	N. by E 5.8
10	West 3.0	SW.. .... 0.1	E.SE. 0.9	SE. 1.2	NW. by W . 1.5	N. by E ... 6.0
11	W. by S.... 3.3	SW. by S... 1.3	SE. by E. .. 2.1	SE. by S ... 2.2	W.SW. 1.5	N. by E 6.1
12	W.SW. 3.3	S.SW 2.0	SE. 2.4	SE. by S. .. 2.2	W. by S.	N. by E 6.2
P. M.						
1	SW. by W.. 3.4	South 2.1	E.SE. 1.8	SE. by S. .. 2.1	SW. by W.....	N.NE 5.8
2	W. by S 3.8	SW. by S... 1.6	E.SE. 1.8	SE. 2.3	N.NE.	N. by E 5.3
3	W. by S 3.5	S.SW 2.0	E. by S..... 1.5	SE. 2.0	SE. by S. .. 0.5	N.NE 5.2
4	West 3.2	S.SW 1.7	E. by S..... 0.5	SE. 1.2	NE. by N... 2.5	N.NE 4.5

Hourly direction and relative velocity of the wind, &c.—Continued.

Time of observation.	JUNE, 1861.					JULY, 1861.
	26th.	27th.	28th.	29th.	30th.	1st.
	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.
P. M.						
5	W. by N....2.5	S.SW......1.3	SE. by E...0.5	SE.........0.9	E.NE......1.4	N. by E....3.8
6	NW. by W.1.9	SW. by S...1.2	NE.........1.0	SE.........0.9	East........0.9	N. by E....3.2
7	West.......1.1	SW. by S...1.3	East........0.1	....	North......0.5	N. by E....1.5
8	W.NW.....0.1	SW.........0.5	....	....	North......2.0	North......0.2
9	....	SW. by S...0.5	....	....	N. by E.....3.2	....
10	....	SW.........0.3	....	....	North......4.2	....
11	W.SW......0.2	SW. by W..0.7	....	....	North......3.1	....
12	W.SW......0.4	SW. by W..0.6	....	W.SW......0.8	N. by E....2.4	....

Time of observation.	2d.	3d.	4th.	5th.	6th.	7th.
A. M.						
1	....	....	S. by E.....0.1	East........0.5	....	S. SW......2.5
2	....	....	SE. by S...0.4	....	....	SW. by S...2.5
3	....	....	....	E. by S.....0.1	SW.........0.6	SW. by S...2.0
4	....	....	....	North......2.0	SW.........0.6	SW.........1.7
5	....	....	S. by W....0.4	E. by N....1.0	SW.........0.8	SW. by S...1.9
6	....	SW. by S...0.1	S. SW......0.4	E. SE......1.4	SW. by S...0.7	SW. by S...1.9
7	SW. by W..1.0	SW.........0.6	S. SW......0.9	South......2.2	SW.........1.1	SW. by S...2.7
8	W. SW.....1.8	SW. by S...1.0	S. by W....1.1	S. by W....1.7	SW.........1.1	S. SW......2.8
9	W. NW....1.6	SW.........1.4	S. SW......2.7	SW.........2.0	SW. by S...2.3	S. SW......2.9
10	W. by N....1.8	SW.........2.6	S. SW......3.1	SW.........2.0	SW.........2.5	S. SW......3.6
11	NW.........1.7	SW. by S...2.2	SW. by S...3.4	SW.........1.4	SW. by W..2.1	S. SW......3.0
12	SE. by E...1.3	S. SW......2.7	S. SW......3.0	SW.........1.2	SE. by E..0.9	S. SW......2.5
P. M.						
1	SE. by E...1.7	SW. by S..2.6	S. SW......3.7	SW.........0.9	SE.........1.0	SW.........2.5
2	SE.........1.7	SW. by S...2.3	S. SW......3.5	SW.........1.4	SE.........1.0	SW.........3.9
3	SE. by E...2.0	SE.........2.3	S. by W....3.0	SW.........2.2	South......1.1	SW. by S...3.7
4	SE.........1.8	SE.........1.7	SE. by S...2.0	SW.........1.4	S. SW......2.4	SW.........3.9
5	SE.........1.5	SE.........1.7	S. SW......2.7	SW.........1.5	SW. by S...1.7	SW. by S...3.9
6	SE.........0.9	SE.........0.8	S. by W....1.8	SE.........1.0	S. by W...1.4	SW.........3.0
7	SE.........0.1	SE.........0.5	South......1.9	S. SE......0.8	South......0.9	SW.........2.2
8	SE.........0.2	....	South......0.7	....	SE. by S....0.5	SW. by S...0.8
9	South......0.5	....	South......0.8	....	SE. by S....0.1	SW. by S...1.2
10	S. by W....0.2	....	South......0.3	....	S. SW......1.8	SW. by S...1.7
11	....	....	South......0.5	....	South......1.2	SW.........2.0
12	....	....	South......0.9	SW. by S...0.2	S. by W....1.6	SW.........1.5

Time of observation.	8th.	9th.	10th.	11th.	12th.	13th.
A. M.						
1	SW.........1.6	W. SW......1.8	N. by E....3.4	....	N. by W...0.5	....
2	SW.........1.1	W. SW......2.3	N. by E....2.6	....	N. by W....2.4	....
3	SW.........1.0	W. SW......1.7	N. by E....3.5	NW.........0.1	North......2.1	....
4	SW by S...0.9	W. SW......1.4	N. by E....2.8	....	N. by W....2.3	....
5	SW.........2.1	W. by S....2.0	North......2.0	....	N. by W....2.7	....
6	West.......1.5	W. by S....1.6	N. by W....1.9	NW.........0.1	North......4.0	....
7	W. SW......1.0	West.......2.7	N. NW.....2.2	NW.........0.1	North......4.7	N. by E....1.6
8	SW. by W..2.1	W. by N...2.9	North......2.4	....	N. by E....5.3	N. by E....1.8
9	W. SW......1.5	NW.........2.4	N. by E....2.8	E. SE......0.4	N. by E....4.7	N. NE......1.5
10	SW. by W..2.3	W. NW.....2.0	N. by E....3.9	SE. by E....0.7	N. by E....4.1	NE.........0.8
11	SW. by W..3.0	W. by S....1.4	N. by E....4.0	SE.........1.1	N. by E....4.5	NE.........0.7
12	W. SW......3.5	SW.........1.6	N. by E....3.0	SE.........2.0	N. by E....4.1	NE.........0.6
P. M.						
1	W. by S....2.7	SW.........1.5	N. by E....4.4	SE. by E...2.8	N. by E....5.4	E. by S.....0.7
2	SW.........1.8	W. SW......2.4	N. by E....4.4	SE.........1.8	N. by E....5.5	East........0.3
3	SW..........	W. by N....2.5	N. by E....4.1	SE. by E...2.2	N. by E....5.5	E. by S.....0.7
4	S. SW..........	N.NE......4.5	N. by E....4.2	SE.........1.5	N. by E....4.6	E. by S.....0.5
5	W. by S..........	East........0.6	N. by E....3.7	SE. by E...1.5	N. by E....3.6	E. by S.....0.7
6	W. SW..........	SE.........0.6	N. by E....2.3	SE. by E...1.5	N. by E....2.8	E. SE......0.1
7	West..........	SW. by S...0.4	North......1.8	N. by W....2.4	North......2.0	SE.........0.5
8	SW.........0.0	..............0.0	N. NW......0.7	East........2.0	North......0.5	....
9	SW.........0.8	..............0.0	NW. by N..0.6	E. by S.....1.1	North......1.0	....
10	West.......1.7	N. by E....0.7	NW.........0.2	SW.........0.4	North......0.5	....
11	West.......2.2	N. by E....1.9	NW.........0.1	NW.........1.0	....	....
12	W. by S....1.7	N. by E....3.0	....	N. by W....1.1	....	....

Hourly direction and relative velocity of the wind, &c.—**Continued.**

JULY, 1861.

Time of observation.	14th. Wind, from whence, and relative velocity.	15th. Wind, from whence, and relative velocity.	16th. Wind, from whence, and relative velocity.	17th. Wind, from whence, and relative velocity.	18th. Wind, from whence, and relative velocity.	19th. Wind, from whence, and relative velocity.
A. M.						
1		S.SW 1.0	W. by N 1.0	West 0.2		W. by S
2		SW 0.8	NW. by W 0.8	West 0.5	SW 0.1	W. by S
3		S.SW 0.2	NW. by W 1.0	W. SW 0.2	SW 0.6	W. NW
4		SW 0.1	NW 0.8	W. SW 0.1	SW. by W 1.0	NW. by W
5		SW 0.3	NW 0.7	W. by S 0.7	SW. by W 1.0	N. NE
6		SW. by W 1.1	NW 1.5	West 1.2	SW 1.1	N. NE
7	S. SE 0.2	W. by S 1.4	NW 1.5	W. by S 0.8	SW. by W 1.5	N. NE
8	S. by W 1.5	W.NW 2.1	North 1.0	W. by S 0.8	SW 1.4	N. NE
9	S. by W 1.5	W.NW 1.7	NE. by E 2.2	West 2.0	SW. by W 1.0	N. NE
10	S. SW 2.5	NW 0.8	NE 2.7	W. by S 2.2	SW. by W 1.5	N. NE
11	SW. by S 2.9	SE. by S 0.5	NE 1.5	SW 1.9	SW. by W 1.9	N. NE
12	S. SW 2.0	SE 1.4	East 1.1	SW 2.1	SW 2.0	NE. by N
P. M.						
1	SE 1.0	S.SE 1.1	SE. by E 1.0	SW 1.8	SW. by S 2.4	NE
2	South 0.9	S.SE 2.0	E. SE 1.3	SW 2.3	SW 2.1	NE
3	SW. by S 1.5	SE. by E 2.4	SE. by E 1.3	SW 2.3	SW. by S 2.4	E. by S
4	S. SW 1.6	SE 2.6	SE. by E 1.1	SW 1.5	SW 2.0	E. by S
5	S. SE 1.4	SE. by S 1.4	SE. by E 1.3	SW 0.1	SW 2.2	SE
6	SE 1.0	SE 0.5	SE. by E 0.6	SE 0.4	SW 0.8	SE
7	S. by W 2.3	East 0.4	SE 0.1	SE 0.1		SE
8	S. SW 2.3	SE. by E 0.2		SW 1.0	SW 0.3	NE. by E
9	S. by W 1.9			W. SW 2.5	N. NE 4.4	N. NE
10	S. SW 1.2			W. by S 2.1	N. NE 1.4	N. NE
11	S. SW 1.4			W. SW 1.2	W. by S 0.2	North
12	SW 1.4		West 0.5	SW 0.4	SW 0.4	NW. by N

Time of observation.	20th.	21st.	22d.	23d.	24th.	25th.
A. M.						
1	N. NW 0.6		NW. by N 0.3			SW
2			N. NW 0.6			SW
3	N. NW 0.5		N. NW 0.4			SW
4	NW. by N. 0.1		NW. by N 0.5			S. SW
5	NW. by N. 0.6		NW. by N 0.7			SW. by S
6	N. NW 0.7		N. NW 0.9			SW
7	N. by W 1.0	E. by S 0.1	North 2.4		SW. by S 0.5	SW
8	North 0.5	E. by S 0.4	N. NE 3.8	N. by W 0.5	SW 1.6	SW
9	NE 0.6	E. by S 1.0	N. NE 3.9	NE 0.4	SW. by S 2.4	SW
10	E. by S 1.3	E.SE 1.0	N. NE 4.6	E. SE 1.3	SW. by S 1.7	SW. by W
11	SE. by E 1.2	E.SE 1.8	N. NE 5.0	E. SE 1.5	SW. by S 0.8	SW. by S
12	SE 1.8	E.SE 2.0	N. NE 5.0	SE 2.0	S. SW 0.3	SW. by S
P. M.						
1	SE. by E 2.0	E.SE 2.1	N. NE 5.2	SE 1.8	SW 3.7	SW. by S
2	SE 1.7	E.SE 1.7	N. by E 5.0	SE 1.7	SW 1.8	SW
3	E. SE 1.6	E. by N 1.5	N. by E 4.8	SE. by E 1.8	SE 1.7	SW
4	E. by S 1.2	E. by N 1.5	N. by E 4.2	SE. by E 1.8	SE 1.8	SW
5	E. by S 1.0	East 1.0	N. by E 3.6	SE 1.2	S. SE 2.2	SW
6	E. by S 0.5	NE. by E 1.3	N. by E 2.9	SE. by S 1.0	SE 1.0	SW. by S
7	East 0.4	N.NE 1.5	North 2.0	S. by E. 0.1	SE. by S 1.7	SW. by S
8	E. by N 0.5	N NE 0.5	N. by W 1.5		SE. by S 1.3	SW. by S
9	E. by N 0.1	N.NE 0.3	N. NW 1.0		S. SE 1.0	SW. by S
10	E. by S 0.1	N.NW 0.3	NW by N 0.5		South 1.1	
11		NW. by N 0.1			S. SW 2.2	S. SW
12					SW 2.2	SW

Time of observation.	26th.	27th.	28th.	29th.	30th.	31st.
A. M.						
1	SW 1.3	0.1	NW 2.1		S. SW 0.6	SW
2	SW 1.5		NW 3.0		SW 2.0	SW. by W
3	SW 1.3		NW 3.4		SW 1.5	W. SW
4	SW 1.2		W. by W 2.9		SW 1.1	SW
5	SW 0.7		W. NW 3.1		S. SW 0.4	SW
6	SW 1.1		W. NW 3.5			SW
7	SW 1.0		NW. by W 4.4	SW 0.1	SE 0.1	SW
8			NW. by W 5.0		SE 0.6	SW. by W

Hourly direction and relative velocity of the wind, &c.—Continued.

Time of observation.	JULY, 1861.					
	26th.	27th.	28th.	29th.	30th.	31st.
	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.
A. M.						
9	W. SW....0.3	NE.........0.5	NW.........4.5	SW. by S...0.5	SE.........0.7	W. SW......3.5
10	SW.........1.4	E.SE.......0.9	NW.........4.1	SW. by S...2.0	SW. by W..1.1	SW. by W..3.2
11	SW. by W..2.5	E. by S.....0.9	NW.........4.2	S. SW......1.8	SW.........2.1	SW. by W..3.3
12	W. SW.....1.8	E. by S.....1.2	NW.........4.0	SW. by S...1.7	SW.........2.7	W. SW.....2.6
P. M.						
1	SW.........1.3	E.NE.......0.9	NW. by N..3.7	SW.........1.0	SW. by S...2.3	SW.........2.9
2	South......0.7	E. by S.....1.0	NW.........3.1	SE. by S....2.4	SW.........3.6	SW. by W..2.5
3	............0.8	East........2.0	NW.........2.9	SE.........1.6	SW.........3.1	SW. by W..3.0
4	............0.7	NE.........1.7	NW.........3.1	SE.........1.0	SW.........3.6	SW. by W..2.3
5	............0.4	NE.........1.7	NW. by W .2.0	SW.........1.5	SW.........2.3	SW. by W..1.7
6	............0.3	SE.........2.2	NW.........1.9	S. by W....1.2	SW.........2.3	SW. by W..0.6
7	............0.2	SE. by S....0.8	NW.........0.1	S. SW......1.3	S. SW......1.2	SW.........0.4
8	............0.1	E.SE.......1.0	N. NW.....0.4	SW.........1.5	S. by W....1.3	............0.0
9	............0.6	SE.........1.6	............0.0	S. by W....1.0	S. SW......1.8	SW.........0.1
10	............0.5	N. by W....0.7	............0.0	SW.........0.7	SW.........1.8	SW.........0.5
11	............0.4	N. by W....1.5	............0.0	SW.........0.1	SW.........2.4	W. SW.....1.7
12	............0.5	N.NW......2.6	............0.0	S. SW......0.1	SW. by W..3.1	SW. by W..0.7

	AUGUST, 1861.					
	1st.	2d.	3d.	4th.	5th.	6th.
A. M.						
1	W. SW.....1.0	SW. by W..0.5	NW.........0.1	S. SE.......0.1	N. by E....1.0	....
2	W. S W.....1.5	SW. by W..0.5	N. by E.....0.9	SW. by S...0.4	N. by E....1.5	....
3	W. S W.....2.1	SW. by W..1.0	North.......1.0	SW. by S...0.2	N. by E....1.0	....
4	W. by S....2.1	SW. by W..1.0	SW. by S...0.2	S. SW......0.2	N. by E....1.5	....
5	West........1.6	SW. by W..1.0	S. by W....0.4	....	N. by E....1.5	....
6	W. by S....1.6	W. SW.....1.2	N. by E.....1.2	S. SW......0.1	N. by E....1.8	....
7	W. SW.....1.9	W. by S....1.9	N. by E.....2.2	SW.........0.5	N. NE......2.4	....
8	W. by S.......	W. by N....3.4	N. by E.....1.5	SW. by W..1.5	N. NE......2.4	E. by N.....0.1
9	W. SW.......	West........2.9	N. by E.....1.2	W. SW.....2.5	N. by E....2.9	S. by W....0.2
10	SW. by W..1.3	W. by S....2.5	N. NE......1.4	W. SW.....2.5	N. NE......2.0	S. SE.......0.9
11	SW.........1.5	W. by N....2.4	N. NE......1.4	SW. by W..3.1	N. NE......2.0	SE. by E....0.5
12	SW. by S...1.8	W.NW.....2.0	E. by N.....0.5	SW. by W..3.4	NE. by E...1.5	SE.........1.0
P. M.						
1	SW.........1.7	E. by N.....1.0	SE.........0.4	SW.........3.1	E. SE......1.2	SE.........1.0
2	SW.........2.4	NE. by E...1.0	E. SE......1.1	SW. by W..3.3	E. SE......0.9	SE. by E....1.3
3	SW.........2.6	East........0.5	SE. by E...0.5	SW. by W..3.0	E. by S.....1.4	SE.........1.2
4	SW. by W..1.9	North.......3.0	SE. by E...0.5	West........3.1	SE.........0.5	SE.........1.3
5	SW. by W..0.9	N. by E.....1.7	E. SE......0.5	NW. by W..2.1	E. SE......0.5	SE.........1.0
6	SW.........0.4	North.......0.6	E. SE......0.2	N. by E....5.0	E. NE......0.5	SE.........0.2
7	SW.........0.3	NE. by N..0.5	E. by S.....0.3	N. by E....3.1	....	....
8	....	North.......0.2	SE.........0.2	N. by E....2.0	....	....
9	SW.........0.7	NE.........0.3	S. SE.......0.3	N. by E....2.5	....	NE. by N...0.8
10	SW.........0.8	NE.........0.1	....	N. by E....1.8	....	N. by E.....1.4
11	SW. by W..0.2	....	....	N. by E....1.5	....	N. by E.....1.6
12	SW. by W..0.8	NE.........0.6	....	N. by E....2.0	....	N. by E.....1.7

	7th.	8th.	9th.	10th.	11th.	12th.
A. M.						
1	N. by E.....1.0	N. NE......1.0	North.......1.2	W.NW.....0.2	N. NE......3.8	NE.........4.0
2	E. NE......0.5	North.......0.4	N. by W....0.7	W.NW.....0.1	N. NE......3.5	NE. by E...3.6
3	NE. by E...0.1	N. NE......0.5	N. NW......0.9	....	N. NE......3.7	NE.........3.9
4	NE.........0.1	N. NE......0.1	N. by W....0.4	....	N. NE......3.7	NE. by E...4.0
5	N. by E.....1.8	....	N. by W....1.0	....	N. NE......3.0	NE. by E...4.0
6	NE.........3.0	N. NE......0.5	North.......1.2	W. by S....0.3	N. NE......2.8	NE.........4.0
7	E. SE......1.6	N. NE......0.5	N. by E.....1.5	W. SW.....0.1	N. NE......2.5	NE.........4.0
8	E. SE......1.0	NE. by N...0.4	N. by E.....2.2	NW.........0.5	NE. by N...2.0	NE.........3.4
9	E. NE......1.5	NE. by N...0.1	N. by E.....2.6	N. NE......2.7	NE. by N...2.2	NE.........3.3
10	E. NE......1.2	NE.........0.1	N. NE......2.4	N. NE......3.2	NE.........2.7	NE.........3.3
11	East........1.3	East........0.1	NE.........1.8	N. by E.....4.0	NE.........3.0	N. NE......4.5
12	NE.........1.9	N. NE......0.9	NE.........1.3	N. NE......4.4	N. NE......3.7	N. NE......5.1

Hourly direction and relative velocity of the wind, &c.—**Continued.**

Time of observation.	AUGUST, 1861.					
	7th.	8th.	9th.	10th.	11th.	12th.
	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.
P. M.						
1	NE.........1.6	N. by E.....2.4	E. SE......1.2	N. NE......3.7	N. NE......4.8	N. NE......
2	N. NE......2.5	N. by E.....2.8	E. SE......1.3	N. NE......4.3	N. NE......5.4	N. NE......
3	N. by E.....4.0	N. by E.....2.7	E. SE......0.7	N. NE......4.5	N. NE......5.3	N. by E.....
4	N. by E.....3.7	N. by E.....3.0	E. by S.....0.7	N. by E.....4.5	N. by E....5.7	N. by E.....
5	N. by E.....3.3	N. by E.....2.2	E. SE......0.7	N. by E.....4.4	N. by E....5.0	N. NE......
6	N. by E.....3.0	N. by E.....2.2	E. SE......0.1	N. by E.....4.3	N. by E....5.3	N. by E.....
7	N. by E.....3.0	N. by E.....2.3	E. SE......0.1	N. by E.....3.6	N. by E....5.2	N. by E.....
8	N. by E.....2.5	North......1.6	....	N. by E.....3.3	N. by E....4.8	N. by E.....
9	North......2.0	N. by E.....1.7	....	N. NE......4.3	NE..........2.1	N. by E.....
10	NE. by N...0.8	N. by E.....1.3	....	N. by E.....4.7	NE..........2.0	N. NE......
11	N. by E.....2.2	North......1.3	....	N. NE......3.9	NE..........3.7	N. NE......
12	N. by E.....1.5	N. by W....1.1	....	N. NE......3.5	NE. by E...3.8	NE. by N...

Time of observation.	13th.	14th.	15th.	16th.	17th.	18th.
A. M.						
1	N. NE......3.9	....	....	SW. by W..0.8	....	....
2	N. NE......3.6	N. NE......0.1	....	W. SW.....0.5	....	....
3	N. NE......3.5	N. NE......0.1	....	SW. by W..0.8	....	....
4	N. by W....2.0	N. NE......0.1	....	....	....	....
5	N. by W....2.2	....	....	....	....	....
6	N. NW......1.2	N. NE......0.1	SW. by S...0.4	....	....	....
7	North......2.0	....	SW. by S...1.1	W. by N....2.0	....	....
8	N. NE......4.0	....	SW. by S...1.7	NW. by W..2.0	East.........0.8	....
9	N. NE......4.0	SE. by E...0.5	S. SW......2.0	West........1.7	E. SE.......0.5	....
10	N. NE......3.5	E. SE.......1.0	S. SW......2.3	SW. by W..2.5	SE..........1.0	SE.........
11	NE. by N...3.5	E. SE.......1.5	SW.........2.3	W. NW.....2.5	SE..........1.5	SE.........
12	NE. by N...3.0	E. SE.......2.0	S. SW......2.5	NW. by W..2.9	SE..........1.7	SE.........
P. M.						
1	NE.........3.0	SE. by E...2.3	SW. by S...2.6	NW.........1.6	SE..........2.8	SE.........
2	NE. by N...3.7	SE. by E...2.7	SW.........2.1	NW.........1.6	SE..........2.7	SE.........
3	NE. by N...4.2	SE..........2.9	SW. by S...2.5	NE..........1.5	SE..........2.8	SE. by S.....
4	N. NE......4.1	SE..........2.5	S. SW......2.2	NE. by E...1.3	SE..........3.0	SE.........
5	N. by E.....4.0	SE..........2.1	S. SW......1.8	NE. by E...1.1	SE..........2.0	SE.........
6	N. by E.....3.5	SE..........1.7	S. SW......1.6	....	SE. by S....1.5	SE.........
7	N. by E.....3.0	SE..........1.0	S. SW......0.2	East.........0.1	....	SE.........
8	N. by E.....2.1	SE..........0.8	S. by W....0.4	....	S. by E.....0.1	S. by E.....
9	N. NE......0.5	S. SE.......0.1	S. SW......0.6	East.........01	SE. by S....0.4	S. by W.....
10	N. NE......0.2	....	SW. by S...0.4	....	....	S. SW......
11	N. NE......0.1	....	SW.........1.6	....	....	....
12	N. NE......0.1	....	SW.........1.0	....	....	....

Time of observation.	19th.	20th.	21st.	22d.	23d.	24th.
A. M.						
1	N. by W....0.1	NW. by N..0.1	....	NW.........0.4	....	....
2	N. NE......0.8	N. NW......0.7	South.......0.4	NW.........0.6	....	....
3	NW.........0.5	N. by W....0.4	South.......0.3	NW. by N..0.7	North.......0.1	....
4	NW.........0.2	North.......0.5	South.......0.5	NW. by N..0.5	....	....
5	NW. by N..0.1	N. by E.....1.5	South.......0.3	NW. by N..0.9	NW. by W.0.3	....
6	N. NW......0.5	N, by E.....1.1	S. by W....0.5	NW. by N..1.3	W. NW.....0.1	....
7	....	N. NE......1.7	NW.........0.5	N. by W....2.5	W. by N....0.4	W. SW......
8	N.NW.......0.8	N. NE......1.8	N. by W....0.4	N. by W....2.2	W. by N... 0.8	SW. by W..
9	North......1.3	N. NE......2.0	N. by W....0.1	N. NE......3.4	W. NW.....0.4	W. SW......
10	NW. by N..1.8	N. NE......2.5	SE. by E....0.5	N. NE......4.0	NW.........0.9	SW. by S....
11	North......1.7	NE..........1.5	SE..........0.5	NE..........4.0	NW.........0.6	SE.........
12	NE..........2.2	NE..........1.0	SE..........1.0	NE..........3.5	E. SE.......1.5	SE. by E....
P. M.						
1	NE. by E...2.3	E. by S.....0.6	E. by S.....0.6	NE..........3.1	E. SE.......1.9	SE.........
2	NE..........2.0	E. NE.......0.9	East.........0.4	NE..........2.9	SE..........2.1	SE.........
3	NE. by E...2.9	E. by S.....0.8	N. by E.....0.7	NE..........2.3	SE..........2.0	SE.........
4	NE..........2.6	E. by N.....1.2	NE. by N...1.3	NE..........2.1	SE..........2.4	SE. by S....
5	NE..........2.8	E. by N.....0.8	N. NE......1.0	NE..........1.4	SE. by S....2.1	S. SE.......
6	NE. by N...1.8	East.........0.4	N. NE......2.0	E. NE.......0.7	SE. by S....1.6	S. SE.......
7	N. NE......0.9	East.........0.1	NE. by N...3.8	NE. by E...0.3	S. by E.....0.9	S. by E.....
8	North......0.1	East.........0.1	NE. by N...3.4	....	South.......0.5	....

Hourly direction and relative velocity of the wind, &c.—Continued.

Time of observation.	AUGUST, 1861.					
	19th.	20th.	21st.	22d.	23d.	24th.
	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.
9	North......0.2	SE. by E....0.1	N. NE......1.8			S. by E.....0.1
10	North......0.1	SE.........0.5	N. by W....1.0			
11	North......0.1		N. NW.....0.8			
12	N. by W...:0.7		NW........0.7			

Time of observation.	25th.	26th.	27th.	28th.	29th.	30th.
A. M.						
1		SW. by S...0.1	SW........1.5		W. by N....0.9	
2			SW. by W..1.1		W. NW....0.7	
3		SW........0.1	SW. by W..0.8		W. by N....0.5	W. by S....0.1
4			SW. by W..0.6		W. by N....0.6	West.......0.1
5			W. SW.....0.8			West.......1.5
6		SW........0.1	West.......1.1	West.......0.2	NW. by W..0.3	W. NW....0.5
7	S. by E.....0.1	SW........0.3	W. by N....1.9	W. by N....0.2	W. NW....0.1	NW........1.0
8	S. SW......0.3	SW. by S...0.8	West.......1.6	W. NW.....1.0	NW. by W..0.5	NW........0.5
9	SW. by S...0.5	S. SW......1.7	W. NW.....1.9	W. NW.....1.1	NW........0.1	N. NW.....0.5
10	SW. by S...1.0	SW........1.8	NW. by W..2.1	W. by S....1.2	NE.........1.4	N. NE......2.4
11		SW........2.0	NW........1.3	W. SW.....1.7	NE. by E...1.7	N. NE......3.0
12		SW........2.0	SW. by W..1.1	West.......1.3	E. SE......1.7	NE.........2.8
P. M.						
1	SW........0.1	SW........2.4	W. by N....1.2	West.......1.6	E. SE......1.6	NE.........2.7
2	SE.........0.5	SW........1.9	E. SE......1.8	W. by S....1.1	E. SE......1.5	NE.........2.6
3	SE.........1.1	SW. by S...2.2	E. SE......1.7	W. SW.....1.1	E. SE......1.8	NE. by E...1.5
4	SE. by S....1.8	SW........2.1	SE.........1.9	W. SW.....1.7	SE. by E...1.1	E. NE......1.3
5	South......1.0	SW. by S...1.4	SE.........1.9	SW. by W..1.0	SE.........1.0	E. NE......1.2
6	SW........0.5	SW........0.9	SE.........0.9	W. SW.....0.9	SE.........0.5	E. by N....0.9
7		SW. by S...0.2	SE.........0.2	West.......0.1	SE. by S...0.1	East........0.2
8	SW. by S...0.2	S. SW......0.4	SE. by S....0.1	West.......0.1		East........0.3
9	S. by W....0.1	SW. by S...0.6		W. by S....0.5		East........0.2
10		SW........1.0		West.......0.5		East........0.3
11	S. SW......0.1	SW........1.4		W. by S....0.5		East........0.2
12	SW. by S...0.2	SW........1.2		W. NW....1.0		East........0.1

Time of observation.	AUGUST, 1861.	SEPTEMBER, 1861.				
	31st.	1st.	2d.	3d.	4th.	5th.
A. M.						
1	East........0.1	South......0.7	SW........0.1	W. by S....0.5	S.SE.......0.2	
2		S. by W....0.4	SE. by S....0.3	W. by S....0.9	NE.........2.0	
3	SE.........0.8	S.SW......0.4			E.NE......2.4	
4	SE.........0.5	S. by W....0.6	SE. by S....1.0		E.NE......2.3	
5	SE.........1.9	S.SW......0.9	NW. by W..2.0		E.NE......1.1	SW. by S...0.5
6	SE.........2.1	SW. by S...1.1	SW. by W..2.1	West.......1.7	East........0.7	SW. by S...1.0
7	SE.........2.0	SW. by S...1.9	SW........1.2	West.......2.2	East........0.9	SW........1.0
8	SE.........2.3	SW. by S...2.0	W.SW.....2.2	NW. by W .2.8	E. by S.....1.3	S.SW......2.0
9	SE.........2.2	S. by W....1.4	NE. by E...2.0	NW. by W .2.5	SE. by E...1.5	SW........2.5
10	SE.........2.7	NW........0.5	SE. by S....1.5	NW........2.9	SE. by E...1.5	SW. by S...2.0
11	SE.........3.0	N. by W....1.5	SE.........0.5	NW........3.8	SE. by E...1.7	SW. by S...2.0
12	SE.........2.8	SE.........1.1	SW........0.5	NW. by W..3.6	SE. by E...1.3	SW........2.9
P. M.						
1	SE.........2.5	SE.........4.4	NW. by W .2.2	NW. by W..2.9	SE. by E...1.6	SW........3.2
2	SE.........2.6	SW........3.0	NW........1.7	NW........2.2	E.SE.......1.5	SW........3.5
3	SE.........2.8	S. by W....2.2	E. NE......1.1	NW........2.0	SE.........2.0	SW........2.5
4		S. SW......0.2	SE. by S....1.0	NW........1.5	SE. by E...1.7	SW........2.3
5		SW. by W..0.5	SE.........0.5	SE.........1.4	SE.........1.7	SW........2.2
6		W.SW.....2.1	SE.........0.4	S.SE.......0.1	SE.........1.0	SW........1.0
7		W. by S....0.1	SE.........0.1		SE.........0.6	SW........0.3
8					SE. by S....0.5	NW........0.3
9	SE.........1.4					W.NW.....0.9
10	SE. by S...1.0					W. by N....1.0
11	S. by E.....0.7					W. by S....0.8
12	S. by E.....1.3			S.SE.......0.1		W. by S....0.7

Hourly direction and relative velocity of the wind, &c.—**Continued.**

Time of observation.	SEPTEMBER, 1861.					
	6th.	7th.	8th.	9th.	10th.	11th.
	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.
A. M.						
1	W.SW 0.8	N. by E 3.6	E. NE 1.5	NE. by E...0.1	SE. by E ...1.6	NW ....
2	W. by S 0.5	N. by E 3.5	E. by N 2.0	....	SE. by E ...1.6	NW ....
3	W. by S 0.2	N. by E 3.2	E. by N 1.7	....	SE. by E ...1.5	NW. by N ..
4	W. by S 0.5	N. by W... 2.3	....	....	SE. by E ...1.5	NW. by N ..
5	W. by S ... 1.0	N. by W....1.9	....	....	SE..........1.0	NW. by N ..
6	W. by S 1.0	N. by W....2.2	....	....	SE..........1.0	W. by S ...
7	W. by S 2.0	N. by W....2.9	NE. by N ...1.1	E. NE 0.1	SE..........1.5	West ......
8	West 3.0	North 2.9	NE. by N ...1.5	E.SE.......1.1	E.SE.......0.5	West ......
9	West........3.0	N. by E 4.0	NE..........2.0	E. by S.....1.6	SE..........0.8	West ......
10	W. by N... 3.2	N. by E 3.8	NE..........1.5	E. by S.....1.9	SE..........1.1	West ......
11	NW. by N ..3.0	N.NE 3.7	NE..........2.0	SE. by E ...1.9	SE..........1.9	North .....
12	NW. by N ..3.0	N.NE 3.4	NE..........2.5	SE 2.1	SE. by E ...2.2	North ......
P. M.						
1	NW.... ...2.8	N. NE 3.7	NE..........2.5	SE 2.1	SE. by E ...2.5	North ......
2	NW.........2.4	N. NE 4.0	NE..........2.3	SE. by E ...2.0	E.SE.......2.0	N. by W....
3	W. by S....2.1	N. NE 3.8	NE..........2.4	SE. by E ...1.5	E.SE.......2.0	....
4	West 2.5	N. by E 3.0	NE..........2.3	SE. by E ...1.2	E.SE.......1.5	N. by W....
5	W.SW 2.0	N. NE 3.0	NE..........2.5	E.SE.......1.1	E. by S.....1.0	N. NW 0.5
6	W. by S....1.0	N. NE 3.0	NE..........1.3	E.SE.......1.2	East........0.6	....
7	West........0.3	N. by E 2.5	E. NE 1.5	SE. by E ...2.0	North 0.9	....
8	NW.........0.8	N. by E 1.8	E. NE 0.6	E. by S.....1.5	North 1.8	....
9	NW.........0.5	NW. by N ..1.1	E. NE 0.1	E.SE.......1.4	N. by W....2.0	....
10	N. by W....1.5	NW.........1.1	....	E.SE.......1.1	N. by W....1.4	N. by W...
11	N. by E 3.5	NW. by N ..1.0	....	SE. by E ...1.5	NW... ....0.7	N. NW ....
12	N. by E 3.5	NE. by N...1.0	E. NE 0.1	SE. by E ...1.8	NW. by N ..0.9	N. NW .....
	12th.	13th.	14th.	15th.	16th.	17th.
A. M.						
1	....	SW. by S...0.5	....	NW. by N ..0.9	E. NE 0.4	North ......
2	W. by N....0.6	SW 1.0	....	NW.........0.6	E. NE 0.1	....
3	West........0.8	SW 0.4	South 0.2	N. by E 3.8	....	....
4	W. by N....0.1	SW. by S...0.6	SW 0.4	N. by E 4.2	N.NE 0.5	....
5	W. by N....0.2	SW 0.5	SW. by W..0.5	N. by E ... 3.5	NE. by E...1.4	....
6	West........0.2	SW. by W..0.5	SW. by W..1.2	N. by E 3.2	E.NE 1.6	NW. by N ..
7	W. SW.....0.5	SW. by W..1.5	W. by S....1.1	N. by E 2.3	NE..........1.0	N.NW .....
8	W. by S 0.3	SW. by W..1.7	W. by S....1.9	N. by E 3.5	NE. by N...1.0	N. by W....1.6
9	SW. by W..1.1	SW. by W..1.9	W. by S....1.6	N. by E 3.7	NE. by E...1.0	N. by E....2.4
10	SW. by W..1.3	SW 2.0	W. by S....1.5	N. by E 4.5	NE. by E...1.5	N. NE 2.1
11	SW 1.5	SW. by S...2.4	W. SW.....1.2	N. by E 4.8	NE. by E...1.5	NE.........
12	SW. by W..1.5	SW. by S...2.5	W. SW.....1.7	N. by E 4.2	E. by N 1.0	NE.........1.5
P. M.						
1	SW. by S...1.7	SW. by S...2.9	W. SW.....2.0	N. by E 4.3	NE..........1.2	NE. by E..
2	SW 1.5	S.SW 2.0	SW. by W..0.8	N.NE 3.7	N.NE 1.0	E. by S....
3	SW. by W..1.3	S. SE.......2.0	E.SE.......0.8	N.NE 3.9	N.NE 0.9	E.SE......
4	SW 1.0	SE. by S....1.5	SE. by E....0.5	N. by E ...3.1	E. NE 1.5	E. by S.....0.5
5	SW. by S ..1.5	SE. by S....1.3	....	N.NE 3.1	E. NE 1.0	SE. by E...
6	S.SW 0.5	SE 0.2	E.NE.......0.8	N.NE 2.2	E. NE 1.0	SE ....
7	....	SE. by S....0.4	N.NE 0.7	N.NE 2.8	E. NE 2.0	S.SE 0.5
8	S. by W 0.4	E.SE.......2.1	N.NE 0.1	N.NE 1.5	E. NE 2.0	S.SE.......0.1
9	S. SW......0.5	E. by S.....1.0	NE..........0.2	NE. by N...0.9	N. by E.....2.5	....
10	....	E. by S.....1.1	NE. by E...0.1	NE.........0.7	N. by E.....2.5	....
11	SW 0.1	E. by S.....1.1	....	NE. by E...0.9	N. by E.....2.8	South 0.3
12	SW 0.5	SE 0.3	E. by N 0.1	E.NE.......0.9	North 2.5	SW. by S...0.1
	18th.	19th.	20th.	21st.	22d.	23d.
A. M.						
1	South 0.4	SW. by S...4.0	....	N. by W....2.6	....	W. by N....0.1
2	South 0.1	SW. by S...2.6	E.SE 0.7	N. by W....3.0	....	W. by N....0.5
3	S.SW 1.0	SW 2.9	E. by S.....1.2	N. by W....2.8	....	W.NW.....0.8
4	S. by W....1.0	SW 3.4	E. by S.....1.1	N. by W....2.2	....	W.NW.....0.7
5	S.SW 1.0	SW. by W..2.6	E. by N 1.0	N. by W....1.5	SE 0.2	W.NW.....1.4
6	S.SW 1.4	SW. by W..2.8	N.NE 3.0	N.NW......1.3	....	W.NW.....1.3
7	S.SW 1.6	SW. by W..2.6	N.NE 3.0	NW. by N ..1.6	SW. by W..0.5	W.NW.....1.3
8	SW. by S...2.3	SW. by W..3.2	N. by E.....3.2	N.NW......2.4	SW 1.2	NW. by W.1.0

Hourly direction and relative velocity of the wind, &c.—Continued.

Time of observation.	SEPTEMBER, 1861.					
	18th.	19th.	20th.	21st.	22d.	23d.
	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.
A. M.						
9	SW. by S...3.3	W.SW.....2.8	N.NE......3.4	N.NW......2.0	W.SW.....2.7	W. by N....0.8
10	SW. by S...3.6	W.SW.....1.7	NE. by E...3.7	N.NW......1.2	SW. by W..2.8	W.NW.....0.3
11	SW........3.0	W.SW.....1.5	NE. by N...1.7	N.NW......1.0	SW. by W..5.0	E.SE.......0.8
12	SW. by S...3.2	W. by S....1.8	NE. by N...1.9	N.NW......1.0	W.SW.....4.3	E.SE.......1.1
P. M.						
1	S.SW......3.5	E.NE.......1.0	North......3.1	N.NE.......1.0	W.SW.....4.2	E.SE.......1.4
2	S.SW......4.0	NE. by E...2.0	N. by W....4.5	E. by N....1.0	W.SW.....3.6	SE.........1.5
3	S.SW......4.2	E.NE.......2.0	N. by E....6.3	E.SE.......0.5	W.SW.....3.8	SE. by E...1.0
4	S.SW......4.3	N.NE.......1.0	N. by W....5.3	E. by S.....0.5	W.SW.....2.6	SE.........0.5
5	S.SW......3.6	N.NE.......1.3	N. by W....4.2	E.SE.......0.1	W. by S....1.7	SE.........0.5
6	South......2.7	E. by N....1.7	N.NW......3.5	E.SE.......0.1	W. by S....1.1	....
7	South......2.3	E. by N....1.7	N.NW......3.0	....	W.SW.....0.7	S. by E.....0.1
8	South......2.5	NE. by N...1.2	N.NW......3.6	....	W. by S....0.9	....
9	South......2.8	N. by E....0.2	N. by W...4.4	....	W. by S....1.5	....
10	S.SW......3.6	N. by E....0.6	N. by W...3.6	....	W. by N....1.5	....
11	S.SW......4.0	N. by E....0.2	N.NW......3.9	....	W. by N....1.4	....
12	SW. by S...3.7	....	N. by W....2.7	....	W. by N....0.6	....

Time of observation.	24th.	25th.	26th.	27th.	28th.	29th.
A. M.						
1	....	SW. by S...0.6	....	W. by N....0.5	NW........0.9	SW........1.0
2	....	SW. by S...0.1	....	W. by N....0.5	NW. by W..0.6	SW. by W..1.0
3	....	S.SW......0.7	W. by S....0.1	W. by N....0.8	NW. by W..0.4	SW. by W..0.8
4	....	S.SW......0.8	W.SW.....0.3	W. by N....0.2	NW. by W..0.4	....
5	S. by W....0.2	S.SW......0.5	W. by S....1.9	W. by N....0.1	West.......0.9	W.SW.....0.1
6	S. by W....0.5	S. by W....0.5	W. by S....1.8	W. by N....0.5	West.......1.1	W. by S....0.5
7	S. by W....0.3	SW........0.7	W. by S....1.7	N. by W....2.5	West.......0.8	West.......0.4
8	SW. by S...1.2	SW. by W..1.2	W. by S....2.1	N.NW......2.9	West.......1.5	W.NW.....1.0
9	S.SW......1.6	SW........1.1	W. by S....2.0	N.NW......2.7	W. by N....2.1	NW. by N..1.1
10	S.SW......2.2	S.SW......0.8	W. by S...2.9	NW. by N..2.9	W.NW.....3.0	NW. by N..1.1
11	S. by W....2.5	S. by E.....1.2	W. by S....2.6	NW........2.5	W. by S....2.8	NW. by N..0.5
12	S.SW......3.2	SE.........1.1	W. by S....2.0	NW........2.5	W.SW.....2.1	N. by W....0.3
P. M.						
1	S.SW......3.5	SW........2.5	W.SW.....2.8	NW. by N..2.5	W.SW.....1.8	N. by W....0.1
2	S.SW......3.5	S.SW......0.7	W.SW.....3.0	NW. by N..2.6	W.SW.....1.9	....
3	S. by W....3.9	S.SW......2.0	W.SW.....2.8	NW........2.6	W. by S....2.4	....
4	South......2.6	S.SW......1.7	W.SW.....2.1	NW. by W.2.8	W.SW.....2.0	N. by W....0.8
5	South......2.0	SW........3.2	W.SW.....2.0	NW. by W.2.0	W.SW.....1.3	N.NE......0.2
6	S.SE.......1.1	NW. by W.2.4	W.SW.....1.0	W.NW.....1.8	....	N.NE......0.2
7	S. by E.....1.4	W. by N....1.9	W.SW.....1.0	W.NW.....0.9	....	N.NE......0.3
8	South......1.7	W..........1.1	SW. by W.1.0	W.NW.....1.3	....	N.NE......0.2
9	South......1.8	W..........1.5	SW. by W.0.7	W. by N....1.6	W.SW.....0.1	....
10	S.SW......1.0	W..........1.9	W.SW.....1.4	W.NW.....1.5	W.SW.....0.1	N.NE......0.2
11	SW. by S..0.5	W..........1.6	SW. by W..0.9	W.NW.....1.4	W.SW.....0.1	North......1.0
12	SW. by S..1.3	W..........0.2	W. by S....1.0	NW. by W..1.5	SW. by W..0.9	N. by E....1.0

Time of observation.	SEPT., 1861.	OCTOBER, 1861.				
	30th.	1st.	2d.	3d.	4th.	5th.
A. M.						
1	N. by E.....1.0	SE. by E...3.0	S.SW......2.5	NW........0.1	NE. by E...0.7	....
2	N. by W....0.5	SE..........3.0	S.SW......2.7	NW........0.3	NE. by E...0.3	....
3	....	SE. by S...2.2	SW. by S...2.6	West.......0.1	NE..........1.2	E.SE.......0.1
4	....	SE. by S...2.4	SW. by S...2.6	....	NE. by N...1.8	SW........0.7
5	....	SE. by S...2.0	SW.........2.7	....	NE..........0.5	W.SW.....2.2
6	....	SE. by S...2.1	SW.........2.7	....	NE. by N...2.0	W.SW.....1.3
7	N. by E.....0.5	S.SE.......0.8	SW.........1.6	....	NE. by N...0.1	W.SW.....1.5
8	N. by E.....0.4	S. by E.....1.1	SW.........2.4	NW........0.5	N.NE......0.3	W. by S....2.2
9	N. by E.....0.9	....	SW. by S...3.4	North......1.0	NE. by N...1.6	West.......3.1
10	N.NE......0.7	....	W.SW.....3.6	NE.........0.7	NE. by N...0.5	W.NW.....3.2
11	SE. by E...2.3	....	W.SW.....4.0	NE.........0.9	E.NE.......0.7	W. by S....3.4
12	SE.........1.5	....	W.SW.....4.9	NE.........1.8	East.......0.8	W. by N....3.6

Hourly direction and relative velocity of the wind, &c.—**Continued.**

Time of observation.	SEPT., 1861.	OCTOBER, 1861.				
	30th.	1st.	2d.	3d.	4th.	5th.
	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity
P. M.						
1	E.SE.......1.6	....	W.SW.....5.2	NE..........1.2	NE. by N...2.5	W. by S....
2	E.SE.......1.5	SE. by S...2.5	SW. by W..4.4	NE. by E...1.9	E.NE.......1.5	West.......
3	SE. by E...1.8	SE. by S...2.1	SW. by W..4.6	NE. by E...2.0	East.........1.0	W. by S....
4	SE. by E...1.6	S.SE.......2.6	W.SW.....3.6	NE. by E...2.0	E.NE.......0.9	W. by N....
5	SE. by E...2.0	S.SE.......1.1	W.SW.....3.2	NE. by E...2.0	NE. by E...0.6	W. by S....
6	SE. by E...2.5	S. by E.....1.2	W.SW.....2.2	E.NE.......2.8	E. by S.....0.6	West.......
7	SE. by E...2.6	S. by E.....2.4	W. by S.....1.4	E.NE.......2.2	East.........0.3	West.......
8	SE. by E...3.1	S. by E.....2.9	W. by S.....1.6	E. by S.....1.5	East.........0.2	West.......
9	SE...........2.3	S. by E.....3.0	W. by S.....1.5	E.NE.......1.7	East.........0.1	NW........
10	SE. by E...2.4	South.......3.3	NW.........1.3	North.......1.7	....	NW........
11	SE. by E...2.5	S. by W....2.7	NW.........0.6	E.NE.......1.1	....	N.NW......
12	SE. by E...3.0	S.SW.......2.7	NW.........0.1	NE..........1.5	....	N.NW......

Time of observation.	6th.	7th.	8th.	9th.	10th.	11th.
A. M.						
1	N.NW.......0.5	SW..........1.1	SW..........0.1	SW. by S...0.7	....	W. by S....
2	NW. by N...0.1	SW..........1.7	SW..........0.1	SW. by S...0.9	....	W.SW.....
3	NW.........0.4	SW..........1.9	SW. by W..0.2	S.SW.......0.7	S.SE.......0.1	W.SW.....
4	NW.........0.7	SW. by S...1.5	SW. by W..0.1	S.SW.......0.3	....	W.SW.....
5	NW.........0.3	SW..........1.9	....	S.SW.......0.3	South.......0.1	W.SW.....
6	NW. by W.0.2	SW..........1.1	....	S.SW.......0.1	South.......0.1	W.SW.....
7	N.NW.......0.1	SW..........0.5	....	S. by W....0.8	S.SW.......0.1	SW. by W..
8	NW. by W.0.1	SW. by S...1.5	....	S. by W....1.7	S.SW.......0.4	W.SW.....
9	NW.........0.5	S.SW.......2.0	S. by E.....0.5	S. by W....2.3	S.SE.......0.5	W.SW.....
10	NW. by N...0.4	S.SW.......2.7	South.......1.0	S. by E.....3.0	SE..........1.7	W.SW.....
11	NW.........0.5	S.SW.......2.9	S.SW.......1.8	SE. by S....2.0	SE..........2.2	SW. by W..
12	West.......0.7	S.SW.......2.9	SW. by S...2.2	SE. by S....2.0	SE..........2.6	SW. by W..
P. M.						
1	SE..........1.3	S.SW.......2.9	SW. by S...3.4	SE..........2.7	SE. by S...2.6	SW. by W..
2	SE..........1.7	S.SW.......3.1	SW. by S...3.1	SE..........2.8	SE. by S...2.5	SW. by W..
3	SE..........2.3	S.SW.......3.0	SW. by S...3.0	SE..........2.4	SE..........1.5	SW. by W..
4	SE..........2.3	S.SW.......2.6	SW. by S...2.6	SE. by S....1.6	South.......1.9	SW. by W..
5	SE. by S...1.8	South.......0.9	SE..........1.3	SE. by S....1.4	S.SW.......2.3	SW........
6	S. by E.....0.4	....	S.SE.......0.9	SE. by S...1.0	SW..........2.2	SW. by S..
7	S. by W....0.2	SW. by S...0.2	S. by E.....0.9	SE. by S...1.0	W.SW.......2.5	S. by W....
8	SW. by S...0.2	....	South.......0.9	....	W.SW.......3.0	S.SW......
9	SW. by S...0.3	....	South.......1.0	S.SE.......0.1	West.......4.0	SW. by S..
10	SW. by S...0.5	SW. by S...0.4	South.......1.8	....	West.......3.3	SW........
11	SW. by S...0.5	SW. by S...0.6	S. by W....1.8	SE. by S...0.1	West.......3.7	SW. by W..
12	SW. by S...0.5	SW..........0.9	S.SW.......1.2	....	W. by S....2.0	W. by S....

Time of observation.	12th.	13th.	14th.	15th.	16th.	17th.
A. M.						
1	W. by S....2.0	....	SW. by S...0.1	....	SW. by W..1.5	....
2	NW.........1.0	W.SW.......0.4	SW. by S...0.1	....	SW..........2.5	....
3	West.......1.2	W. by S....0.1	W.SW.......0.5	....	SW. by W..1.5	....
4	W.SW.......0.5	NW. by W..0.5	W.SW.......0.5	....	W.SW.......1.8	....
5	SW..........0.3	W. by N....0.5	W. by S....1.5	....	SW..........0.7	....
6	W. by S....2.0	NW. by W..0.7	W. by N....1.7	....	SW..........0.4	....
7	West.......3.5	NW.........0.1	W. by N....1.2	....	SW. by S...0.1	SW. by S...0.1
8	W.NW.......3.9	W. by S....0.5	W.NW.......0.9	....	S.SW.......0.5	N.NE.......1.6
9	NW. by W..4.6	West.......0.6	N.NE.......4.2	....	SW..........0.1	N.NE.......
10	NW. by W..5.0	W.SW.......0.5	N. by E....5.0	SW. by S...0.5	SW. by W..0.8	N.NE.......
11	NW. by W..4.5	South.......0.5	N.NE.......5.0	SW..........0.5	SW. by W..1.7	N. by E....
12	W.NW.......4.0	....	N.NE.......4.5	S.SE.......0.5	SW..........1.8	N.NE.......
P. M.						
1	W.NW.......4.0	....	N.NE.......3.5	S.SE.......0.1	S.SW.......1.7	N.NE.......
2	NW. by W..4.4	E.SE.......1.5	N.NE.......2.0	S.SE.......0.3	S.SW.......2.5	N.NE.......
3	W.NW.......3.6	SE..........1.7	E.NE.......1.1	S.SE.......0.1	S.SW.......1.9	N.NE.......
4	W.NW.......4.0	SE. by S....1.8	E.NE.......0.4	....	S.SW.......1.9	N.NE.......6.1
5	NW. by W..2.1	SE..........0.4	....	....	SW. by S...1.7	N.NE.......
6	N. by W....1.2	....	....	....	SW. by S...1.1	N.NE.......
7	N.NW.......0.7	S. by W....0.1	....	....	SW. by S...0.2	N.NE.......
8	....	....	....	....	....	N. by E....

Hourly direction and relative velocity of the wind, &c.—Continued.

Time of observation.	OCTOBER, 1861.					
	12th.	13th.	14th.	15th.	16th.	17th.
	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.
P. M.						
9	....	....	....	....	SW. by S...0.1	North 4.7
10	....	....	....	SW. by S...0.2	....	North 5.5
11	....	....	....	SW.........0.3	....	North 5.1
12	NW........0.1	SW. by S...0.2	....	SW. by W..0.5	....	North 5.3
	18th.	19th.	20th.	21st.	22d.	23d.
A. M.						
1	North 5.3	W.SW.......1.3	W.NW.......0.6	S.SE.......1.2	....	W. by N....3.0
2	N. by E....4.9	W.SW.......0.8	W.NW.......0.1	SE. by S...1.5	....	W. by N....2.7
3	North 3.7	W.SW.......1.3	NW. by W..0.3	S.SE.......1.5	....	W.NW.......2.3
4	North 4.0	W.SW.......2.0	NW.........0.1	S.SE.......1.0	....	NW. by W .2.6
5	North 3.4	W. by S....2.7	....	S. by E.....0.9	W.SW.......0.1	NW. by W .1.3
6	N. by E.....3.1	W. by S....3.0	....	....	W.SW.......0.1	NW. by W .2.0
7	N. by E.....3.0	W.NW.......3.3	....	....	W. by S....0.3	W.NW.......1.5
8	North 3.0	W.NW.......3.3	....	S.SE.......0.6	West.......2.3	W. by N....2.5
9	N. by E....3.1	W.NW.......3.5	....	SE.........2.0	West.......2.2	W.NW.......2.5
10	N. by E....3.3	....	S. by E.....0.4	SE. by S...2.5	W. by N....2.1	W.NW.......2.0
11	N. by E....3.3	....	SE. by E...1.1	SE.........2.1	W. by N....1.9	W.NW.......2.4
12	N. by E....2.8	NW. by W..4.3	SE. by E...1.0	SE. by E...2.8	W. by N....3.3	West.......2.4
P. M.						
1	N.NE.......2.7	NW. by W..4.2	E.SE.......1.3	SE. by E...3.1	W. by N....3.1	W.NW.......2.5
2	N.NE.......3.3	W.NW.......4.8	E.SE.......1.7	SE. by E...2.5	West.......4.0	West.......1.7
3	NE. by N...2.2	W. by N ...4.6	SE. by E...1.5	SE. by E...1.5	W. by N....2.8	NW.........2.7
4	NE. by N...2.3	West.......3.5	SE.........1.8	E.SE.......0.5	NW.........2.5	W.NW.......3.4
5	NE. by N...1.1	W. by N....2.3	SE.........1.6	....	NW. by W..2.6	W.NW.......2.1
6	NE. by N...0.2	W.NW.......1.0	SE.........0.3	....	W.NW.......2.7	W. by N....2.2
7	....	W.NW.......0.1	SE.........0.8	....	W.NW.......2.7	West.......1.1
8	....	W. by S....0.3	SE.........1.0	NW. by N..0.6	W.NW.......3.2	W. by N....1.5
9	....	W.SW.......0.7	SE. by S...1.0	....	West.......3.5	W. by N....1.5
10	W.SW.......0.2	West.......0.8	SE. by S...0.5	....	W.NW.......2.5	W. by N....0.5
11	W.SW.......0.7	W. by N....0.6	SE. by S...1.0	....	West.......1.9	W. by N....0.5
12	W.SW.......1.2	W.NW.......0.8	SE. by S...0.8	....	West.......2.4	W.NW.......0.1
	24th.	25th.	26th.	27th.	28th.	29th.
A. M.						
1	W. by N....0.2	S. SW......0.8	W. by S....0.1	....	S. by W....0.4	S. by E.....1.7
2	NW. by W..0.2	S. SW......1.5	W. by S....0.4	....	SW. by S...0.1	S. by E.....2.1
3	....	S. SW......2.7	....	....	....	South 1.7
4	....	S. SW......2.7	West.......0.1	....	....	South 1.7
5	....	S. SW......2.5	West.......0.1	....	....	S. by W....1.8
6	....	SW. by S...1.9	W. by S....0.3	....	South 0.2	S. SW......1.0
7	....	SW. by S...1.8	West.......0.3	....	South 0.3	SW.........2.0
8	....	SW. by S...2.2	NW. by W..0.7	....	S. SW......0.1	SW. by S...1.9
9	SW.........0.1	SW. by W..1.5	NW. by W..1.6	....	S. SW......1.4	SW. by W..3.7
10	S. SW......1.0	SW.........1.7	NW. by W..2.3	....	S. by W....2.0	SW.........3.9
11	S. by W....2.0	SW. by W..3.0	NW.........1.1	....	S. SW......3.0	SW.........4.7
12	S. SW......2.0	SW. by W..2.4	NW.........1.4	....	South 3.0	SW. by S...4.5
P. M.						
1	S. SW......2.5	SW. by W..1.9	W.NW.......2.5	SE. by S....2.3	South 3.0	SW. by S...5.8
2	S. SW......1.9	SW.........1.5	NW. by W..2.9	SE.........3.2	SE.........2.5	SW. by S...5.7
3	S. SW......2.2	SW.........1.8	NW. by W..2.3	SE. by S....2.8	SE. by S....2.4	S. SW......3.7
4	S. by W....2.3	SW.........0.2	West.......2.3	SE. by S....2.6	SE. by S....1.6	S. SW......3.8
5	S. by E.....1.1	....	NW.........0.5	S. SE.......2.0	SE. by S....1.3	S. SW......2.0
6	S. by E.....0.5	....	....	S. SE.......1.0	SE. by S....1.4	SW. by W..2.1
7	S. by E.....0.4	....	....	S. SE.......0.2	SE. by S....0.7	SW. by W..2.4
8	S. by E.....0.8	....	....	S. by E.....0.2	S. SE.......1.9	W. SW......2.2
9	South......2.1	....	....	S. by E.....0.1	S. by E.....2.2	W. by S....2.5
10	S. by W....2.1	....	....	....	South 1.7	West.......3.3
11	S. by W....2.1	W. SW......0.1	....	South 0.4	South 1.8	W. by S....2.6
12	S. SW......1.4	W. SW......0.4	....	S. by W....0.1	S. by E.....2.1	West.......3.8

Hourly direction and relative velocity of the wind, &c.—**Continued.**

Time of observation.	OCTOBER, 1861.		NOVEMBER, 1861.			
	30th.	31st.	1st.	2d.	3d.	4th.
	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.
A. M.						
1	W. by N....2.7	W. NW.....1.5	N. by W....0.1	NE. by N...2.5	NW.........1.0	West........0.3
2	W. NW....2.2	W. by N....1.7		NE. by N...3.0	NW. by N..1.5	W. by S....0.3
3	W. by N....2.1	W. by N....1.7		NE. by N...3.8	NW. by N..2.1	
4	W. by N....1.9	W. NW.....1.2	N. NE......0.7	NE. by N...3.9	N. NW.....1.4	
5	W. by N....2.6	W. by N....1.0	N. by W....1.4	NE. by N...3.8	NW. by N..1.3	
6	W. by N....3.4	W. by N....1.6	N. NE......0.7	NE. by N...4.1	NW. by N..1.2	
7	West.......3.5	W. NW....1.9	E. NE.....1.2	NE. by N...4.3	NW. by N..1.3	
8	West.......4.3	W. by N....1.8	E. NE......1.6	NE. by N...4.4	NW. by N..2.5	
9	W. by N....4.4	W. NW.....0.6	NE. by E...1.7	NE. by N...4.5	NW. by N..2.8	
10	W. by N....4.0	W. NW.....1.0	NE.........2.2	N. NE......4.2	NW.........2.5	
11	W..........3.8	W. by N....0.5	NE. by E...2.3	N. by E.....4.5	W. NW.....2.9	South......0.2
12	W. by N....3.7	W. by S....0.4	NE. by E...2.5	N. by E.....5.0	W. by N....2.9	S. SW......0.4
P. M.						
1	West.......3.6	W. SW.....0.1	NE. by E...2.2	N. by E.....5.1	W. by N....2.7	S. SW......0.3
2	West.......3.6		NE. by N...2.3	N. by E.....6.0	West........3.4	S. SW......0.5
3	West.......3.3	W. SW.....0.1	NE. by N...3.0	N. by E.....6.2	W. by N....3.0	S. by W....0.7
4	W. by N....3.2	W. SW.... 0.4	NE. by N...4.1	N. by E.....5.6	West........2.5	S. SW......1.2
5	West.......3.0		NE. by N...3.4	North......2.2	West........1.6	S. SW......0.2
6	W. by N....2.5		NE. by N...3.5	N. by W....3.2	West........1.3	
7	W. by N....2.1		N. by E.....1.6	N. by W....2.8	W. by S.....1.1	W. SW....0.3
8	West.......1.9	N. NW.....0.1	E. NE......1.4	N. by W....2.3	W. by S....0.2	W. SW.....1.6
9	West.......2.2		NE. by N...1.6	N. by W....1.9		W. SW.....0.5
10	West.......2.3		NE. by N...2.0	N. by W....2.3	W. by S....0.2	W. by S....0.5
11	W. NW.....2.4		NE. by N...2.4	N. by W....1.5	W. by N....0.2	W. by S....1.2
12	W. by N....1.4		NE. by N...2.1	N. NW.....1.5	W. by N....0.9	W. by S....1.5

	5th.	6th.	7th.	8th.	9th.	10th.
A. M.						
1	W. by N....1.0	W. NW.....0.3		W. NW.....0.7		S. by E.....0.6
2	West.......0.4	W. by N....0.5		NW........0.7		S. by E.....0.4
3		W. NW.....0.4		NW........0.1	N. NW.....0.2	S. by W....0.1
4	W. SW.....0.1	West.......1.1			N. NW.....0.2	
5	W. SW.....0.4	W. by N....2.0		NW. by N..0.5		
6	W. SW.....0.2	W. NW.....1.1		NW. by N..1.1		S. SE.......1.6
7	W. SW.....0.1	W. NW.....1.8		N. by W....2.2		S. SE.......2.0
8	W. SW.....0.6	NW........2.0		N. by W....3.2		S. by E.....3.0
9	SW. by W..0.1	NW........2.8		N. by E....3.1		S. by E.....3.5
10	SW.........0.2	NW........2.3	S. SW......1.3	N. by E....2.8		S. by E.....4.4
11	SW.........0.8	NW........2.5	SW. by S...2.5	N. NE......2.6		S. by W....4.0
12	SW. by S...1.9	NW. by W..2.7	S. SW......2.1	N. NE......3.0	NE. by E...0.1	S. SW......4.1
P. M.						
1	SW. by S...1.5	NW. by W..3.0	S. SW......2.4	NE.........1.7	E. by S.....0.6	SW. by S...4.2
2	S...........1.0	NW. by W..2.8	S. SW......2.3	NE.........0.8	SE. by E....0.8	SW.........3.9
3	S. by E.....1.1	W. NW.....2.8	SW. by S...2.1	NE. by N...0.5	SE. by S....1.0	SW.........3.8
4	S. SW......2.0	W. NW.....1.6	S. by W....0.6	NE. by N...0.6	S. SW.......0.5	SW. by W..2.1
5	SW. by S...0.2	W. NW.....0.1			S. by E.....0.1	W. SW.....2.8
6					South......0.2	W. SW.....3.1
7					S. SW.......0.7	W. by S....3.3
8						West.......3.6
9						W. by S....3.2
10	W. by S....0.1					W. by S....3.5
11					South......0.3	West.......3.1
12	W. by N....0.2		West.......0.4		S. by E.....0.6	West.......2.0

	11th.	12th.	13th.	14th.	15th.	16th.
A. M.						
1	West.......1.1			NE. by N...1.4		N. NW.....0.6
2	W. by S....0.8			E. NE......0.4	NW.........0.1	N. NW.....0.4
3	West.......3.0		NW. by W..0.5	E. NE......0.9	N. NW.....0.1	N. NW.....0.3
4	West.......3.4		NW........0.2	E. NE......1.2	NW.........0.1	N. NW.....0.3
5	West.......3.4		NW........0.3	E. NE......1.6	W. NW.....0.1	N. by W....0.5
6	W. by S....2.9			E. by S.....1.1	W. NW.....0.1	NW. by N..0.3
7	West.......3.7	SE..........0.3		East.......0.9	W. NW.....0.2	NW.........0.1
8	W. by N....4.1	SE. by S....1.2		East.......1.2	W. by N....0.8	NW.........0.1

Hourly direction and relative velocity of the wind, &c.—Continued.

NOVEMBER, 1861.

Time of observation.	11th.	12th.	13th.	14th.	15th.	16th.
	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.
A. M.						
9	W. by N....4.0	SE. by S....1.5	NW. by N..1.0	E. by S.....0.9	NW. by W..0.8	N. NW.....1.0
10	West........3.5	SE. by S....1.7	NW. by N..1.6	E. by S.....1.1	NW. by W..1.4	NW........0.7
11	W. by S....3.2	SE. by S....2.4	NW. by N..1.1	E. by S.....0.9	NW........1.0	NW. by W..0.8
12	W. by N....2.2	SE. by S....2.1	NW........0.8	East........0.5	N. NW.....2.1	N. NW.....0.5
P. M.						
1	W. by S....1.5	SE. by S....1.2	NW........0.7	E. by N.....1.0	N. NW.....2.5	N. by W....1.0
2	W. by S....1.1	SE. by S....1.5	NW. by N..0.8	E. NE......1.2	N. by W....2.1	N. by W....0.9
3	W. by S....0.9	SE. by S....1.3	N. NW.....0.6	E. NE......1.3	N. NW.....1.4	N. NE......1.1
4	W. by S....0.1	SE. by S....0.5	N. NW.....0.3	NE........0.6	N. by W....0.7	N. NE......1.2
5		SE. by S....0.1		N. NE......0.9	N. by W....0.3	NE........0.2
6		SE. by S....0.4		NE.........0.5	N. by W....0.7	
7				NE.........0.5		
8				NE. by N..0.1		
9						NW. by N..0.3
10			N. by W....0.1	N. by W....0.4		NW........0.2
11			NE. by N..2.5	W. NW.....0.2		N. NW.....0.1
12			NE. by N..2.8	NW.........0.1	N. NW.....0.3	NW. by N..0.1

Time of observation.	17th.	18th.	19th.	20th.	21st.	22d.
A. M.						
1	NW. by N..0.2	North......0.1	SE.........3.4	S.SE.......5.0	W.SW......0.4	S.SE.......2.9
2	..........0.1	N.NW......0.2	SE.........3.3	S.SE.......3.2	W.SW......0.1	S.SE.......2.4
3	NW........0.2		SE. by S...3.6	S. by E....2.3	W.SW......1.0	S.SE.......2.3
4	NW........0.1	N. by E....0.6	SE. by S...3.5	S. by W....2.4		S.SE.......2.6
5	NW........0.2	N. by E....0.4	SE. by S...3.8	S.SW.......2.3		S.SE.......2.0
6	NW. by W.0.1		SE. by S...4.0	SW. by S...2.6		S.SE.......2.2
7		NW. by N..0.5	SE. by S...4.6	S.SW.......3.2		S.SE.......2.5
8		NW........1.0	SE. by S...5.0	S.SW.......3.5		S. by E.....1.8
9		NE. by N...1.0	SE. by S...5.0	SW. by S...3.5		S. by E.....1.8
10	N. NW.....0.1	E.NE......1.9	SE. by S...4.7	SW.........3.3		S.SE.......2.2
11	N. NE.....0.5	E.NE......1.2	SE.........4.7	SW.........4.0	SE.........1.0	S. by E.....2.2
12	NE. by N...0.9	E.NE......1.7	SE.........5.7	SW. by W..4.1	SE.........2.2	W.SW......2.9
P. M.						
1		E.NE......2.0	SE.........5.4	SW. by W..3.0	SE.........2.4	W. by S....3.8
2	NE.........0.3	E.NE......1.9	SE.........5.6	SW. by W..3.7	SE. by S...2.8	W. by S....3.6
3	NE. by E...0.1	E.NE......1.1	SE. by E...5.5	W.SW......3.8	S.SE.......2.8	W. by S....2.7
4	E. NE......0.2	E.NE......1.5	SE. by E...6.4	W.SW......3.2	S.SE.......2.1	W. by S....3.5
5		E. by N....0.9	SE. by E...6.5	W.SW......2.7	SE. by S...1.8	W. by S....3.7
6		E. by N....0.6	S.SE.......3.7	W.SW......2.8	SE. by S...2.3	W. by S....4.1
7		E. by S....0.6	S.SE.......4.0	W.SW......2.0	SE. by S...3.7	W. by S....4.1
8		E. by S....1.1	S.SE.......5.2	W.SW......2.2	S.SE.......2.0	W. by S....4.7
9		E.SE......1.5	S.SE.......4.6	W.SW......0.9	S.SE.......2.6	W. by S....4.5
10		SE. by E...1.9	S.SE.......4.9	W.SW......0.9	S.SE.......1.0	W.SW......3.5
11	N. by W...0.3	SE.........2.0	S.SE.......4.2	SW. by W..0.1	S.SE.......2.4	W.SW......3.5
12	North......0.7	SE.........2.6	S.SE.......3.8	W.SW......0.4	S.SE.......3.2	W.SW......3.0

Time of observation.	23d.	24th.	25th.	26th.	27th.	28th.
A. M.						
1	W. SW.....4.0	W.NW.....3.3	W.NW.....3.5	NW.........0.4	S. SW......2.3	W. by N....1.0
2	W. SW.....4.0	W.NW.....2.5	W.NW.....4.0	NW.........0.1	SW..........2.2	W. by N....1.0
3	W. SW.....4.3	W. by N....1.9	W.NW.....4.3	NW.........0.1	W. SW.....2.0	
4	W. SW.....4.5	W. by N....2.0	W.NW.....3.2		W. SW.....4.0	
5	W. SW.....4.3	W.NW.....2.0	W.NW.....3.0		West.......3.6	
6	W. SW.....4.0	NW.........2.5	W.NW.....3.5		W. NW.....2.9	
7	W. SW.....4.0	N.NW......2.0	W.NW.....2.0		W. NW.....3.5	SW. by S..0.2
8	W. SW.....4.1	NW. by N..2.5	W. by N....2.0		W. NW.....4.5	W. SW.....0.3
9	W. SW.....4.4	N.NW......3.5	NW. by N..1.8	W. SW.....0.4	W. NW.....5.2	
10	W. by S....4.3	N.NW......3.0	N.NW......2.2	SW..........1.1	W. NW.....4.3	
11	W. by S....4.7	N. by W....3.0	N. by W....2.9	SW. by S...2.3	W. by N....4.0	
12	W. by S....4.9	N. by W....3.0	NW. by W.2.1	S. SW......2.4	W. by N....4.2	S. SW......0.5
P. M.						
1	W. by S....5.1	N. by W....2.6	NW. by W.2.5	S. SW......2.8	W. by N....4.3	South......0.1
2	W. by S....5.0	N. by W....2.7	N. NW.....2.4	S. by W....3.0	W. by N....3.7	S. by E.....2.2
3	W. by S....4.4	N.NW......2.4	N. NW.....1.6	S. SW......2.4	West.......3.0	SE. by S...2.3
4	W. by S....4.6	NW.........2.3	N. by W....1.6	S. SW......2.6	W. by N....2.9	SE. by S...2.8

Hourly direction and relative velocity of the wind, &c.—**Continued.**

Time of observation.	NOVEMBER, 1861.					
	23d.	24th.	25th.	26th.	27th.	28th.
	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.
P. M.						
5	W. by S....4.8	NW........2.4	N. by W....0.6	S. SW......1.4	West........1.2	SE. by S ...1
6	W. by S....4.2	NW. by W .2.0	N. by W....0.2	S. SW......1.8	W. by N....1.3	S. SE.......3
7	West........4.9	NW. by W .2.5	N. by W....0.1	S. by E.....2.8	W. by N....2.3	S. SE.......
8	W. by N....4.6	NW. by W .2.3	N. by W....0.1	S. by E.....3.6	W. by N....1.2	S. SE......
9	W. by N....4.3	NW. by W .3.0	N. NW.....0.4	S. by E.....2.4	W. by S....1.0	SW. by W..1
10	W. by N....2.9	W.NW 2.7	NW.........0.5	S. by E.....2.1	West........0.5	W. SW....1
11	W. by N....3.1	W.NW.....3.0	NW.........0.5	South 2.7	W. by S....0.4	W. by S....4
12	W.NW.....2.8	W.NW.....2.8	....	S. by E.....2.9	West........0.1	W. NW 4

Time of observation.	NOVEMBER, 1861.		DECEMBER, 1861.			
	29th.	30th.	1st.	2d.	3d.	4th.
A. M.						
1	NW. by W..4.5	W. by N....3.9	....	NW........0.7	....	SW 2
2	NW.........4.5	W. NW 4.4	NW. by W..0.6	NW........1.0	....	SW 2
3	W. by N....3.5	W. NW 4.8	NW. by W..0.3	....	....	SW 2
4	W. NW 2.6	W. NW 4.5	NW. by W..0.6	....	....	SW.........2
5	W. by N....3.9	W. NW 3.0	NW. by W..1.2	....	....	SW 2
6	W. by N....3.0	W. NW 1.5	NW. by W..1.0	NW. by W..0.4	....	SW 2
7	W. NW 2.1	W. by N....1.3	NW. by W..1.3	W.NW.....0.1	....	SW 2
8	W. NW 3.0	W. by N....1.2	NW. by W..2.0	W.NW.....0.5	....	SW 1
9	W. NW 4.5	W. by N....1.2	W.NW.....2.0	....	....	SW 1
10	NW. by W..3.5	W. by N....0.8	W.NW.....2.1	West........1.0	....	SW 2
11	W. NW 3.5	West........1.5	W.NW.....2.9	W.NW.....1.4	West........1.5	SW 2
12	West........3.5	W. by S....1.0	W.NW.....3.0	W.NW.....1.5	W. SW.....1.5	SW 2
P. M.						
1	W. by N....3.1	W. by S....0.1	W. by N....3.0	W.NW.....1.1	SW. by W..2.4	SW 3
2	W. NW 2.6	W. by N....0.9	W. NW 4.0	W.NW.....1.3	SW 2.3	SW 2
3	W. NW 2.0	W. by W ...0.2	W. NW 3.2	NW. by W..1.4	SW 1.3	SW 2
4	W. by N....2.5	W. by S....0.3	West........2.8	NW. by W..0.7	SW. by W..1.0	SW 2
5	W. by S....1.2	....	W. by N....0.9	NW. by W..0.5	SW 1.2	SW ....
6	W. by S....0.2	....	W. by N....1.1	W. by N....1.0	SW 1.3	SW 0
7	W. by S....1.4	....	W. NW 2.0	....	SW 1.5	SW 1
8	W. by S....1.5	....	W. NW 3.4	....	SW 2.5	....
9	W. NW 2.5	....	W. NW 4.0	....	SW 2.0	....
10	W. NW 4.0	W. NW 0.4	NW. by W..3.5	....	SW 1.9	....
11	W. NW 3.5	W. NW 0.1	NW.........0.2	....	SW 1.1	....
12	W. by N....4.9	....	NW 1.1	....	SW.........1.5	....

Time of observation.	5th.	6th.	7th.	8th.	9th.	10th.
A. M.						
1	....	SW 1.5	SW 2.0	W. SW.....0.2	....	SW 0
2	....	SW 1.6	SW 3.5	W. SW.....1.2	....	SW 1
3	....	SW 1.1	SW 3.9	W. SW.....2.0	....	SW 1
4	....	SW. by W..1.0	SW 3.6	W. SW.....1.0	....	SW 1
5	....	SW. by W..2.8	SW 3.5	W. SW.....0.6	SW. by S...0.1	SW 0
6	....	SW. by W..3.0	SW. by S...2.5	....	SW. by S...0.5	SW 1
7	....	SW. by W..2.6	SW. by W..1.5	W. SW.....1.0	SW. by S...1.0	SW 2
8	....	SW. by W..2.5	SW 2.0	W. SW.....1.0	SW. by S...1.0	SW 2
9	....	SW 3.0	SW 1.7	W. NW 1.1	SW. by S...1.4	SW 2
10	....	SW 3.0	SW 1.3	W. NW 0.9	SW. by S...1.0	SW 2
11	....	SW 3.0	SW 0.8	....	SW. by S...1.6	W. SW.....4
12	....	SW 3.0	SW 0.6	....	SW 2.7	West 4
P. M.						
1	....	SW 3.0	SW 0.6	SW 0.5	SW 2.8	W. NW.....5
2	....	SW 2.0	....	SW 0.5	SW 3.4	NW. by N ..6
3	....	SW 1.6	SW 0.5	SW 1.2	SW 2.0	NW. by N ..5
4	....	SW 2.3	SW 1.7	SW. by S...0.8	SW 0.1	NW 4
5	SW 0.4	SW 2.1	SW 1.5	SW. by S...0.5	SW 0.4	NW 4
6	SW 0.1	SW 4.0	SW 0.3	SW. by S...0.1	SW 0.1	NW 4
7	....	SW 4.8	SW 0.4	SW. by S...0.4	SW 0.2	NW 4
8	SW 0.5	W. SW.....1.7	W. SW.....0.9	....	SW 0.3	NW 4
9	....	SW. by W..2.5	SW. by W..0.2	SW. by S...0.5	SW 1.0	NW 4
10	....	SW. by W..3.7	SW. by W..0.4	....	SW 1.0	NW 3
11	....	SW 2.3	....	....	SW 0.5	NW 3
12	....	SW 1.5	W. SW.....1.0	....	SW 0.9	NW. by N ..3

Hourly direction and relative velocity of the wind, &c.—Continued.

Time of observation.	DECEMBER, 1861.					
	11th.	12th.	13th.	14th.	15th.	16th.
	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.	Wind, from whence, and relative velocity.
A. M.						
1	NW. by N..2.5	W. by S....0.5	SW. by S...2.1	W. by S....0.5	NE. by N...1.2	W. SW.....2.5
2	NW. by N..2.8	W. SW.....1.0	SW. by S...1.4	W. SW.....1.1	NE..........2.3	W. SW.....2.7
3	NW. by N..2.7	W. by S....0.8	W. SW.....2.0	SW. by W..1.2	NE. by E...1.8	W. SW.....3.9
4	NW. by N..2.0	W. by S....0.4	W. by S....1.4	SW. by W..1.3	....	W. SW.....3.8
5	NW. by N..2.0	W. by S....0.3	W. by S....0.9	SW. by W..1.4	....	W. SW.....4.4
6	NW. by N..1.2	W. by S....0.4	W. by S....0.6	SW. by W..1.3	....	W. SW.....4.8
7	NW. by N..1.8	W. by S....0.5	W. SW.....1.2	SW. by W..0.7	....	SW. by W..4.6
8	NW. by N..2.0	W. SW.....1.6	....	SW. by W..1.4	E. by S.....1.6	SW. by W..5.5
9	NW. by N..1.3	W. SW.....2.4	....	W. SW.....2.0	SE. by E...2.0	SW. by W..5.3
10	NW. by N..0.7	W. SW.....2.1	....	W. SW.....1.5	SE..........2.6	SW. by W..4.1
11	W. NW.....0.5	SW. by W..2.9	....	NW.........1.6	SE. by S....2.2	W. SW.....4.5
12	W. by S....1.5	SW. by W..3.0	....	N. NW.....2.5	S. by E.....1.8	W. SW.....3.6
P. M.						
1	W. by S....1.5	SW.........3.8	....	N. NE......3.5	S. by E.....1.7	SW. by W..3.6
2	W. SW.....0.5	SW.........3.6	SW. by W..1.8	N. NE......4.0	S. by W....1.3	SW. by W..3.8
3	W. by S....1.0	SW.........3.5	SW. by W..1.7	N. NE......4.1	S. by W....1.3	SW. by W..2.2
4	W. by S....0.8	SW.........2.0	SW. by W..0.9	N. NE......3.9	S. SW......0.4	W. SW.....2.9
5	W. by S....0.6	SW.........2.5	SW. by W..0.1	N. NE......2.9	S. SW......0.1	....
6	W. by S....0.1	SW.........1.5	SW. by W..0.5	N. NE......2.5	S. SW......0.8	....
7	W. by S....0.9	SW.........1.7	SW. by W 0.9	N. NE......1.8	S. SW......0.5	....
8	W. by S....1.1	SW.........2.1	SW. by W..2.2	N. NE......0.7	S. SW......1.7	....
9	....	SW.........2.1	W. SW.....2.8	....	SW.........2.2	....
10	W. by S....1.0	SW.........2.0	W. SW.....2.6	....	SW. by W..2.1	....
11	W. by S....0.5	SW.........1.8	W. SW.....2.4	NE. by N...1.2	SW. by W..1.7	E. by S.....1.2
12	W. by S....0.7	SW. by S..2.2	W. by S....1.1	NE. by N...1.6	W. SW.....2.1	E. by S.....1.1
	17th.	18th.	19th.	20th.	21st.	22d.
A. M.						
1	E. by S.....0.8	E. NE......0.5	W. NW....0.7	N. NE......3.2	....	E. NE......0.1
2	....	....	W. NW....0.4	N. NE......3.7	....	....
3	SE..........0.3	E. NE......0.1	W. NW....0.5	NE..........4.2	N. NW....0.1	E. by S.....0.1
4	....	NE. by E...0.7	NW.........0.5	NE. by N...3.8	NW. by N..0.1	NE. by E...0.7
5	....	NE. by N...0.3	NW.........0.6	NE..........4.1	N. NW.....0.3	NE..........0.6
6	....	NE. by E...0.6	NW.........0.1	NE. by N...3.4	....	S. SW......1.8
7	....	N. by E.....0.4	NW. by N..0.8	NE..........3.6	N. NW.....0.1	S. SW......2.1
8	W. SW.....0.2	....	NW. by N..1.3	NE. by N...3.8	NW. by N..0.3	S. by W....1.7
9	W. by S....1.2	N. by E.....0.3	N. NW.....1.9	NE..........2.7	NW. by N..0.2	S. by W....2.4
10	West.......1.4	SE..........0.6	N. NW.....1.7	NE..........2.8	NW. by N..0.8	South......2.4
11	W. by N....2.3	SE. by E....0.9	NE..........2.8	NE..........2.4	NW.........0.2	S. SE.......2.6
12	West.......2.6	SE. by S....0.7	NE. by E...2.4	NE..........2.2	NW.........0.8	SE..........3.1
P. M.						
1	SW. by W..2.8	S. SW......0.7	NE. by E...0.6	NE. by N...2.4	NW. by W..0.1	SE. by E....3.0
2	SW. by W..2.7	S. SW......1.3	N. NW.....0.6	NE. by N...2.6	NW. by W..0.1	SE. by E....3.4
3	SW. by W..2.3	SW. by S...1.5	N. NW.....1.2	NE. by N...2.9	W. NW.....1.3	SE. by E....3.5
4	SW. by W..2.0	SW. by S ..1.0	N. NW.....1.8	NE. by N...2.6	W. NW.....0.4	SE..........3.6
5	SW. by W..2.0	SW.........1.0	North......2.4	N. NE......2.1	NW. by W..0.1	SE..........3.6
6	SW. by W..1.5	SW. by W..0.9	NE..........3.0	NE..........1.1	NW.........0.1	SE. by E....3.6
7	SW. by W..1.8	SW. by W..0.6	NE. by E...2.5	NE. by N...1.2	....	SE. by E....3.6
8	SW. by W..1.8	S. SW......1.0	NE. by E...2.8	N. NE......0.7	....	E. SE.......4.6
9	SW. by W..2.5	S. SW......0.9	NE. by E...3.0	NE..........1.1	....	E. SE.......6.5
10	W. SW.....3.7	West.......1.6	NE. by E...2.7	NE..........1.3	....	E. by S.....6.1
11	W. SW.....3.4	W. by N....1.4	NE. by E...2.9	NE. by E...0.9	....	E. by S.....5.8
12	SW.........0.8	W. by N....0.9	N. NE......3.2	NE..........0.5	....	E. NE......4.5
	23d.	24th.	25th.	26th.	27th.	28th.
A. M.						
1	E. NE......4.8	NW.........0.1	....	SW. by W..3.0	SW. by W..6.5	S. SE.......1.3
2	E. NE......4.3	....	W. NW.....0.1	SW. by W..3.7	W. SW.....6.0	S. SE.......1.7
3	E. NE......3.8	....	N. NW.....0.3	SW. by W..2.3	W. SW.....5.1	S. SE.......1.0
4	E. NE......3.8	....	North......0.1	W. SW.....2.0	W. SW.....3.9	S. SE.......2.0
5	E. NE......4.0	....	NE..........0.2	W. SW.....1.9	W. SW.....1.5	S. SE.......1.0
6	E. NE......3.8	....	E. NE......0.2	W. SW.....1.0	W. SW.....1.5	S. SE.......1.0
7	NE. by E...3.4	W. SW.....0.2	East........0.1	W. by S....0.6	SW. by W..0.5	SE. by S....1.0
8	NE. by E...3.6	W. by S....0.5	....	W. by S....1.4	SW. by W..0.5	SE. by S....1.9
9	NE. by E...3.0	W. SW.....1.1	E. by N.....0.1	West........1.0	SW. by W..1.3	SE..........2.1
10	NE. by E...2.7	SW. by S...1.2	E. NE......0.5	W. NW.....1.8	SW. by W..1.7	SE. by S....2.8
11	E. NE......2.4	W. SW.....1.3	East........0.1	NW.........3.4	SW. by W..1.0	SE. by S....2.9
12	E. NE......2.3	W. SW.....0.9	....	NW. by N..5.3	SW. by W..1.0	SE. by S....3.4

Hourly direction and relative velocity of the wind, &c.—**Continued.**

DECEMBER, 1861.

Time of observation.	23d. Wind, from whence, and relative velocity.	24th. Wind, from whence, and relative velocity.	25th. Wind, from whence, and relative velocity.	26th. Wind, from whence, and relative velocity.	27th. Wind, from whence, and relative velocity.	28th. Wind, from whence, and relative velocity.
P. M.						
1	NE.........1.8	SW. by W..1.4	E. by S 0.1	SW. by W..5.7	W. SW.....0.5	SE. by S....1.8
2	NE 1.9	SW. by W..2.1	SE. by E....0.4	SW. by W..5.7	SW 0.2	SE. by S....2.1
3	NE. by N...1.1	SW. by W..2.5	South 6.0	SW. by W..6.4	SW 0.1	SE ....1.
4	N. NE......0.4	SW. by W..2.9	SW. by S...2.8	SW. by W..6.3	S. SE.......0.1	SE. by S....1.3
5	....	SW. by W..2.6	S. SW.....2.8	SW. by W..5.8	....	SE. by S....1.2
6	....	W. SW.....1.5	SW 1.8	W. SW.....5.4	S. by W....0.1	S. SE........1.1
7	....	W. NW 0.8	SW. by S...2.6	SW. by W..6.2	SW. by S...0.1	S. SE........1.4
8	NW 0.1	W. by N....1.0	SW. by S ..3.1	SW. by W..7.0	S. SW 0.1	S. SE........0.5
9	....	West.......1.5	SW. by S...3.5	W. SW.....8.0	S. by W....0.1	....
10	N. NW 0.4	W. by S....1.4	SW 3.5	SW. by W..6.7	S. SE.......0.6	....
11	....	West.......0.6	SW 2.6	SW. by W..7.3	South 0.8	....
12	....	W. SW.....0.5	SW 2.7	SW. by W..7.5	South 1.7	....

Time of observation.	29th.	30th.	31st.
A. M.			
1	....	....	S. by W 2.0
2	....	....	S. by E.....1.0
3	W. SW.....0.5	....	S. by E.....0.6
4	W. SW.....0.4	....	South 0.5
5	West.......0.2	....	S. by E.....0.4
6	West.......0.6	....	....
7	W. by N....0.5	....	South 0.5
8	W. by N....0.8	....	S. by E.....0.6
9	West.......0.6	South 0.2	S. SW......0.7
10	NW. by W..1.0	S. by E.....0.8	SW. by S...1.3
11	NW 0.9	S. by E.....2.4	SW. by S...1.2
12	NW. by W..0.4	S. SE 2.2	SW 2.2
P. M.			
1	NW. by W..0.1	S. SE 1.9	SW. by S...1.8
2	W. NW 1.0	S. SE 1.8	S. SW......1.2
3	W. NW 0.1	S. SE 1.2	S. SW......1.0
4	SW. by W..0.4	S. SE 1.0	SW. by S...0.4
5	....	S. by E.....0.8	S. by W 0.1
6	....	S. SE 0.4	S. by W 0.5
7	....	S. SE 0.9	S. by W 0.2
8	....	S. SE 0.9	SW. by S...1.8
9	....	....	SW 1.2
10	....	....	SW. by S...0.9
11	....	S. by E.....0.6	SW 0.8
12	....	S. by E.....0.4	SW 1.3

TABLE M.—*First reduction of the winds from the hourly records, September,* 1861, *Milwaukee, Wisconsin.*

N.	N. by E.	N. NE.	NE. by N.	NE.	NE. by E.	E. NE.	E. by N.	E.	E. by S.	E. SE.	SE. by E.	SE.	SE. by S.	S. SE.	S. by E.	S.	S. by W.	S. SW.	SW. by S.	SW.	SW. by W.	W. SW.	W. by S.	W.	W. by N.	W. NW.	NW. by W.	NW.	NW. by N.	N. NW.	N. by W.	Calm.
2.9	3.5	3.7	1.0	2.0	1.1	1.1	2.0	0.7	1.3	1.5	1.5	1.1	0.3	0.1	0.1	0.7	0.4	0.4	1.1	3.0	0.5	2.1	0.1	1.7	1.0	0.9	2.0	0.5	3.0	0.5	1.5	5
0.9	3.5	3.4	1.1	2.0	0.1	2.4	1.7	0.9	1.6	1.1	1.5	4.4	1.0	0.1	1.4	0.2	0.6	0.9	1.9	0.1	2.1	2.2	0.5	2.2	3.2	0.8	2.2	1.7	1.1	0.3	1.5	1
1.8	3.6	3.7	1.5	1.5	0.1	2.3	0.1	0.6	1.9	1.1	1.7	0.5	1.5	0.2	1.2	0.3	1.4	0.2	2.0	1.2	1.1	0.8	0.9	3.0	0.6	0.7	2.8	2.9	1.0	0.1	2.3	5
0.1	3.5	4.0	0.9	2.0	0.9	1.1	1.0	....	1.5	1.2	1.3	0.5	1.0	2.0	....	0.4	2.2	2.0	0.5	0.5	1.3	2.0	0.8	3.0	0.1	1.4	2.5	3.8	0.9	1.2	1.9	5
0.1	3.2	3.8	1.0	2.5	1.4	1.5	1.7	....	1.0	1.4	1.5	0.4	0.5	0.5	....	0.1	0.4	0.5	1.0	1.0	1.5	0.5	0.7	2.5	0.2	1.3	2.6	2.2	0.3	3.5	2.2	8
0.3	4.0	3.0	1.2	2.5	1.0	1.5	1.7	....	1.0	1.1	1.7	0.1	1.5	0.1	....	2.7	1.0	0.5	2.0	2.5	1.3	1.2	0.5	0.3	1.5	1.3	2.9	2.0	0.1	3.0	2.9	2
2.5	3.8	3.0	1.7	2.3	1.5	0.6	1.0	....	1.1	0.5	1.9	1.4	1.3	1.1	....	2.3	0.2	2.0	2.0	2.9	0.5	1.7	0.2	0.1	1.4	0.3	3.0	1.5	0.9	3.6	2.0	5
1.8	3.0	0.7	1.9	2.4	1.5	0.1	1.0	....	1.1	2.0	2.0	2.0	0.4	....	....	2.5	0.5	1.0	1.7	3.2	1.5	2.0	0.5	0.1	0.6	1.8	1.0	0.3	0.8	3.9	1.4	1
3.1	2.5	0.1	....	2.3	1.2	0.1	....	....	0.6	2.0	1.5	1.7	....	....	....	2.8	0.3	1.0	1.5	3.5	1.7	2.8	1.0	0.1	0.1	0.9	2.4	2.8	1.6	1.3	0.1	4
1.0	1.8	3.7	....	2.5	2.0	0.1	....	....	0.5	1.5	1.2	1.0	....	....	....	2.6	2.5	1.4	0.5	2.5	1.9	1.7	1.0	0.1	0.5	1.3	2.8	2.4	2.9	2.4	0.2	1
....	3.8	3.9	....	1.3	3.7	0.8	....	....	1.2	2.1	2.0	0.6	....	....	....	2.0	3.9	1.6	0.6	2.3	0.5	1.5	2.0	0.8	0.8	1.5	2.0	0.8	2.5	2.0	0.1	1
....	4.2	3.1	....	0.2	....	0.9	....	....	1.1	0.8	1.5	2.1	....	....	....	1.7	0.5	3.5	2.4	2.2	1.2	2.7	2.1	0.2	1.9	1.4	1.5	0.5	2.6	1.2	1.6	1
....	3.5	2.2	....	0.7	....	0.4	....	....	0.5	0.6	1.8	2.1	....	....	....	1.8	....	4.0	2.5	1.0	0.8	4.3	1.0	1.1	0.5	3.0	0.6	1.1	1.1	1.0	4.5	2
....	3.2	2.8	....	1.0	....	0.1	....	....	....	0.7	1.6	1.0	....	....	....	....	....	4.2	2.9	0.3	2.6	4.2	0.4	1.5	0.5	1.0	0.4	0.7	1.1	1.0	5.3	1
....	2.3	1.5	....	1.2	....	0.5	....	....	....	0.5	1.6	1.0	....	....	....	....	....	4.3	0.1	1.5	2.8	3.6	0.3	1.9	0.2	....	0.4	0.7	0.5	2.9	4.2	1
....	3.5	1.0	....	1.7	....	1.6	....	....	....	0.1	1.5	1.5	....	....	....	....	....	3.6	2.3	1.5	2.6	3.8	1.1	1.6	0.1	....	....	0.8	....	2.7	4.4	1
....	3.7	0.9	....	1.5	....	1.5	....	....	....	0.1	1.5	0.8	....	....	....	....	....	3.6	3.3	1.0	3.2	2.6	1.9	0.2	0.5	....	....	0.6	....	....	3.6	2
....	4.5	2.3	....	....	....	1.0	....	....	....	0.8	2.2	1.1	....	....	....	....	....	4.0	3.6	0.1	0.5	0.7	1.6	0.9	1.6	....	....	2.5	....	....	2.7	2
....	4.8	1.0	....	....	....	1.0	....	....	....	1.1	2.5	1.9	....	....	....	....	....	1.6	3.2	0.5	2.8	0.3	1.5	1.1	2.1	....	....	2.5	....	....	2.6	10
....	4.2	1.3	....	....	....	2.0	....	....	....	1.4	0.5	0.2	....	....	....	....	....	2.2	3.7	1.0	5.0	2.8	1.8	0.8	....	....	....	2.6	....	....	3.0	1
....	4.3	3.0	....	....	....	2.0	....	....	....	1.6	0.4	0.3	....	....	....	....	....	3.2	4.0	0.4	1.2	3.0	1.7	1.5	....	....	....	0.9	....	....	2.8	1
....	3.1	3.0	....	....	....	1.0	....	....	....	1.5	1.0	0.6	....	....	....	....	....	3.5	2.6	0.5	1.0	2.8	1.1	0.4	....	....	....	....	....	....	2.2	9
....	2.5	3.4	....	....	....	1.0	....	....	....	....	2.3	0.2	....	....	....	....	....	3.5	1.2	2.0	0.7	2.1	0.9	....	....	....	....	....	....	....	1.5	2
....	2.5	1.0	....	....	....	....	....	....	....	....	1.8	1.5	....	....	....	....	....	1.0	0.5	0.4	0.9	2.0	1.5	....	....	....	....	....	....	....	2.5	3
....	2.8	0.2	....	....	....	....	....	....	....	....	1.6	0.5	....	....	....	....	....	0.7	1.3	3.0	0.9	1.0	0.1	....	....	....	....	....	....	....	0.3	1
....	2.4	0.2	....	....	....	....	....	....	....	....	2.0	0.5	....	....	....	....	....	0.8	0.6	2.9	1.0	1.0	1.9	....	....	....	....	....	....	....	0.1	2
....	0.2	0.3	....	....	....	....	....	....	....	....	2.5	1.1	....	....	....	....	....	0.5	0.1	3.4	0.8	1.4	1.8	....	....	....	....	....	....	....	0.8	2
....	0.6	0.2	....	....	....	....	....	....	....	....	2.6	1.5	....	....	....	....	....	0.8	....	1.2	....	2.1	1.7	....	....	....	....	....	....	....	0.5	....
....	0.2	0.2	....	....	....	....	....	....	....	....	3.1	2.3	....	....	....	....	....	0.7	....	0.7	....	1.8	2.1	....	....	....	....	....	....	....	....	....
....	3.2	0.7	....	....	....	....	....	....	....	....	2.4	....	....	....	....	....	....	2.0	....	1.1	....	1.9	2.0	....	....	....	....	....	....	....	....	....
....	6.3	....	....	....	....	....	....	....	....	....	2.5	....	....	....	....	....	....	1.7	....	2.5	....	2.0	2.9	....	....	....	....	....	....	....	....	....
....	1.0	....	....	....	....	....	....	....	....	....	3.0	....	....	....	....	....	....	....	....	3.2	....	1.3	2.6	....	....	....	....	....	....	....	....	....
....	1.0	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1.0	....	0.1	2.0	....	....	....	....	....	....	....	....	....
....	0.5	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0.1	1.0	....	....	....	....	....	....	....	....	....
....	0.4	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0.1	0.8	....	....	....	....	....	....	....	....	....
....	0.9	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0.1	2.8	....	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2.4	....	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0.5	....	....	....	....	....	....	....	....	....
14.5	102.0	61.4	9.3	29.6	15.4	24.6	10.2	2.2	14.4	24.7	57.7	33.9	7.5	4.1	2.7	20.1	13.9	60.9	49.1	54.1	41.9	66.2	49.6	25.1	17.4	17.6	31.1	33.8	21.6	30.6	58.7	79
10	36	30	8	17	11	23	8	3	13	22	32	29	8	7	3	13	12	31	27	33	27	36	38	22	19	14	15	21	15	16	28	627 hours.

TABLE N.—*Second reduction, September,* 1861, *Milwaukee, Wisconsin.*

Observed.				Reduced.		
Points.	Hours duration.	Relative velocity.	Amount.	Points.	Duration.	Amount.
North	10	1.45	14.5	North	10.3	14.93
N. by E	36	2.83	102.0	N. by E	37.2	105.46
N.NE	30	2.04	61.4	N.NE	31.0	63.50
NE. by N	8	1.16	9.3	NE. by N	9.3	9.52
NE	17	1.74	29.6	NE	17.6	30.61
NE. by E	11	1.40	15.4	NE. by E	11.4	15.97
E.NE	23	1.07	24.6	E.NE	23.7	25.45
E. by N	8	1.27	10.2	E. by N	8.3	10.55
East	3	0.73	2.2	East	3.1	2.27
E. by S	13	1.11	14.4	E. by S	13.4	14.88
E.SE	22	1.12	24.7	E.SE	22.7	25.55
SE. by E	32	1.80	57.7	SE. by E	33.1	59.67
SE	29	1.17	33.9	SE	30.0	35.06
SE. by S	8	0.94	7.5	SE. by S	8.3	7.68
S.SE	7	0.59	4.1	S.SE	7.3	4.31
S. by E	3	0.90	2.7	S. by E	3.1	2.77
South	13	1.55	20.1	South	13.4	20.79
S. by W	12	1.16	13.9	S. by W	12.4	14.36
S.SW	31	1.97	60.9	S.SW	32.1	62.98
SW. by S	27	1.82	49.1	SW. by S	28.0	50.76
SW	33	1.64	54.1	SW	34.1	55.95
SW. by W	27	1.55	41.9	SW. by W	28.0	43.33
W.SW	36	1.85	66.2	W.SW	37.2	68.46
W. by S	38	1.31	49.6	W. by S	39.3	51.30
West	22	1.14	25.1	West	22.7	25.96
W. by N	19	0.92	17.4	W. by N	19.7	17.99
W.NW	14	1.26	17.6	W.NW	14.4	18.20
NW. by W	15	2.07	31.1	NW. by W	15.5	32.16
NW	21	1.61	33.8	NW	21.7	34.95
NW. by N	15	1.44	21.6	NW. by N	15.5	22.33
N.NW	16	1.91	30.6	N.NW	16.5	31.64
N. by W	28	2.10	58.7	N. by W	29.0	60.70
Calm	79			Calm	81.7	
Sums	706	46.62	1005.9	Sums	730.0	1040.13

TABLE O.—*Mean relative velocity of the wind at the several points of the compass, in miles per hour,* 1861, *Milwaukee, Wisconsin.*

Points.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
North	2.15	....	1.76	1.88	0.98	1.45	3.79	1.00	1.25	1.78
N. by E	3.24	....	2.03	3.91	2.94	2.83	3.71	3.72	0.35	2.84
N.NE	3.99	....	2.30	2.86	2.57	2.04	3.98	1.66	2.62	2.75
NE. by N	3.31	....	1.72	0.90	2.04	1.16	1.43	2.64	2.16	1.92
NE	2.85	....	1.23	1.05	2.39	1.74	1.11	0.85	2.15	1.67
NE. by E	2.02	....	1.09	1.83	2.08	1.40	1.21	1.48	2.14	1.66
E.NE	2.79	....	1.83	0.90	0.99	1.07	1.38	1.25	2.51	1.59
E. by N	2.30	....	0.10	0.92	0.77	1.27	0.00	0.83	0.10	0.79
East	2.44	....	0.56	0.92	0.31	0.73	0.48	0.86	0.10	0.80
E. by S	2.23	....	0.80	0.71	0.73	1.11	1.05	0.90	2.10	0.95
E.SE	2.48	....	1.15	1.29	1.18	1.12	1.02	1.50	5.55	1.91
SE. by E	3.28	....	1.01	1.46	1.01	1 80	2.06	4.22	2.55	2.17
SE	2.97	....	1.10	1.13	1.71	1.17	1.88	3.22	2.21	1.93
SE. by S	2.85	....	1.45	1.10	1.26	0.94	1.73	2.52	1.94	1.72
S.SE	2.81	....	0.35	1.24	0.82	0.59	0.87	2.78	1.23	1.59
S. by E	1.97	....	0.80	0.10	0.54	0.90	1.33	2.10	1.01	1.09
South	2.14	....	0.62	0.98	0.50	1.55	1.37	0.75	0.96	1.11
S. by W	2.07	....	0.83	1.46	0.28	1.16	1.59	1.47	0.97	1.23
S.SW	2.62	....	1.40	1.87	1.09	1.97	1.91	1.80	1.07	1.72
SW. by S	2.96	....	2.32	1.92	0.96	1.82	1.59	2.10	1.35	1.88
SW	3.24	....	1.49	1.70	1.34	1.64	1.52	2.41	1.79	1.89
SW. by W	3.64	....	2.37	2.05	1.37	1.55	2.53	2.04	2.67	2.28
W.SW	3.02	....	2.46	1.76	1.33	1.85	1.82	2.27	2.18	2.09
W. by S	2.85	....	1.62	1.36	1.21	1.31	1.65	2.43	0.82	1.66

Mean relative velocity of the wind at the several points, &c.—Continued.

Points.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
West	2.65	....	2.04	1.39	1.24	1.14	2.38	2.25	1.52	1.83
W. by N	2.09	....	3.07	2.25	1.57	0.92	2.17	2.43	1.29	1.97
W.NW	2.25	....	1.10	2.03	0.89	1.26	2.31	2.58	1.63	1.76
NW. by W	2.86	....	2.27	2.25	1.46	2.07	2.25	2.16	0.85	2.02
NW	2.09	....	1.26	1.89	0.69	1.61	0.70	1.03	1.94	1.40
NW. by N	1.89	....	2.83	0.83	0.77	1.44	0.37	1.21	2.11	1.43
N.NW	1.82	....	1.54	0.85	0.77	1.91	0.41	1.12	1.01	1.18
W. by W	1.13	....	0.00	1.55	0.99	2.10	1.20	1.49	0.00	1.06
Sums	83.00	....	46.50	48.34	38.80	46.62	52.80	61.07	52.13	53.66
Means	2.60	....	1.45	1.51	1.21	1.46	1.65	1.91	1.63	1.68

TABLE O.—*Duration and amount of wind at the several points of the compass for the year* 1861, *Milwaukee, Wisconsin.*

Points.	DURATION OF WIND.										AMOUNT OF WIND.									
	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
North	34	7	23	20	19	10	11	3	2	129	73.0	....	40.4	37.7	18.6	14.5	41.7	3.0	2.5	231.4
N. by E	38	25	39	45	70	36	10	11	2	276	123.6	....	79.1	176.1	206.0	102.0	37.1	40.9	0.7	765.5
N.NE	48	51	79	26	69	30	19	9	14	345	191.8	....	182.0	74.4	177.0	61.4	75.7	14.9	36.7	813.9
NE. by N	28	13	15	1	17	9	10	26	13	131	92.7	....	25.8	0.9	34.7	9.3	14.3	68.5	28.1	274.3
NE	18	35	24	12	40	17	7	8	18	179	51.2	....	29.5	12.6	95.6	29.6	7.8	6.8	38.6	271.7
NE. by E	9	10	8	3	14	11	7	6	16	84	18.2	....	8.7	5.5	29.1	15.4	8.5	8.9	34.3	128.6
E.NE	42	16	3	1	7	23	9	17	14	132	117.3	....	5.5	0.9	6.9	24.6	12.4	21.3	35.1	224.0
E. by N	15	13	1	5	7	8	0	3	1	53	34.5	....	0.1	4.6	5.4	10.2	0.0	2.5	0.1	57.4
East	21	19	8	9	17	3	5	3	2	87	51.3	....	4.5	8.3	5.3	2.2	2.4	2.6	0.2	76.8
E. by S	16	10	8	19	6	13	2	7	8	89	35.7	....	6.4	13.6	4.4	14.4	2.1	6.3	16.8	99.7
E.SE	29	21	18	14	25	22	5	1	2	137	72.0	....	20.8	18.1	29.4	24.7	5.1	1.5	11.1	182.7
SE. by E	16	32	16	20	12	32	8	5	8	149	52.4	....	16.1	29.3	12.1	57.7	16.5	21.1	20.4	225.6
SE	45	54	63	47	64	29	24	12	8	346	133.8	....	69.6	53.2	109.4	33.9	45.2	38.6	17.7	501.4
SE. by S	20	5	6	11	10	8	31	27	11	129	56.9	....	8.7	12.1	12.6	7.5	53.5	68.0	21.3	240.6
S.SE	7	2	2	7	6	7	19	29	20	99	19.7	....	0.7	8.7	4.9	4.1	16.5	80.6	24.6	159.8
S. by E	4	3	2	2	8	3	21	18	11	72	7.9	....	1.6	0.2	4.3	2.7	27.9	37.8	11.1	93.5
South	25	5	9	14	6	13	20	6	7	105	53.0	....	5.6	13.7	3.0	20.1	27.4	4.5	6.7	134.0
S. by W	7	5	3	15	6	12	16	6	10	80	14.5	....	2.5	21.9	1.7	13.9	25.4	8.8	9.7	98.4
S.SW	14	5	20	37	15	31	44	24	16	206	36.7	....	28.0	69.2	16.4	60.9	85.2	43.2	17.1	356.7
SW. by S	13	3	27	42	20	27	41	10	29	212	38.5	....	62.5	80.6	19.2	49.1	65.0	21.0	39.1	375.0
SW	23	28	40	113	30	33	33	8	114	422	74.5	....	59.6	191.9	40.3	54.1	50.0	19.3	203.5	693.2
SW. by W	7	12	21	26	24	27	24	7	74	222	25.5	....	49.9	53.2	32.8	41.9	60.8	14.3	197.9	476.3
W.SW	9	16	33	20	17	36	42	40	57	270	27.2	....	81.2	35.3	22.6	66.2	76.4	90.7	124.0	523.6
W. by S	17	14	17	15	11	38	26	47	27	212	48.4	....	27.5	20.4	13.3	49.6	42.6	114.2	22.2	338.2
West	25	36	16	10	14	22	39	25	13	200	66.2	....	32.6	13.9	17.4	25.1	92.8	56.1	19.8	323.9
W. by N	19	27	3	5	11	19	40	42	10	176	39.8	....	9.2	11.1	17.3	17.4	86.9	101.9	12.9	296.5
W.NW	24	24	11	7	13	14	37	50	29	209	53.9	....	24.2	14.2	11.6	17.6	84.3	128.8	47.4	382.0
NW. by W	7	15	6	6	7	15	22	16	18	112	20.4	....	13.6	13.5	10.2	31.1	49.4	34.5	15.3	188.0
NW	27	30	16	25	16	21	22	33	23	213	56.4	....	20.1	47.4	11.0	33.8	15.3	33.9	44.5	262.4
NW. by N	16	4	3	9	7	15	3	20	20	97	30.3	....	8.5	7.5	5.4	21.6	1.1	24.3	42.1	140.8
N.NW	12	8	10	14	7	16	6	28	11	112	21.8	....	15.4	11.9	5.4	30.6	2.5	31.3	11.9	130.8
N. by W	10	4	0	12	15	28	1	30	0	100	11.3	....	0.0	18.5	14.8	58.7	1.2	44.7	0.0	149.2
Calm	47	16	98	96	119	79	128	138	125	846	....	....	....	....	....	....	....	....	....	....
Sums	692	568	648	708	729	706	732	715	733	6231	1750.4	....	939.9	1080.4	998.1	1005.9	1133.0	1194.8	1113.4	9215.9

TABLE P.—*Comparative duration and amount of wind at the several points of the compass reduced to the mean month of* 730 *hours, at Milwaukee, Wisconsin, for the year* 1861.

Points.	DURATION OF WIND.										AMOUNT OF WIND.									
	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
North	35.9	9.0	26.0	20.6	19.0	10.3	11.0	3.1	2.0	136.9	77.01	....	45.46	38.86	18.62	14.98	41.68	3.06	2.49	242.16
N. by E	40.1	32.0	44.0	46.4	70.1	37.2	10.0	11.2	2.0	293.1	130.39	....	89.00	181.55	206.29	105.48	37.09	41.71	0.70	792.21
N. NE	50.6	65.3	89.1	26.8	69.1	31.0	18.9	9.2	14.0	374.0	202.35	....	204.65	76.70	177.25	63.50	75.52	15.29	36.55	851.81
NE. by N	29.6	16.6	17.0	1.0	17.0	8.3	10.0	26.5	13.0	139.0	97.78	....	29.05	0.93	34.74	9.52	14.25	69.88	27.98	284.13
NE	19.0	45.0	27.0	12.4	40.1	17.6	7.0	8.2	17.9	194.2	54.01	....	33.26	12.99	95.73	30.61	7.77	6.94	38.45	279.76
NE. by E	9.5	12.9	9.0	3.1	14.0	11.4	7.0	6.1	15.9	88.9	19.20	....	9.81	5.67	29.14	15.97	8.47	9.08	34.16	132.50
E. NE	44.3	20.5	3.4	1.0	7.0	23.7	9.0	17.3	13.9	140.1	123.84	....	6.27	0.93	6.91	25.45	12.36	21.73	34.95	232.44
E. by N	15.8	16.7	1.1	5.2	7.0	8.3	0.0	3.1	1.0	58.2	36.40	....	0.10	4.74	5.41	10.55	0.00	2.55	0.10	59.65
East	22.3	24.2	9.0	9.3	17.0	3.1	5.0	3.1	2.0	95.0	54.12	....	5.10	8.56	5.31	2.27	2.39	2.65	0.20	80.60
E. by S	16.8	12.9	9.0	19.6	6.0	13.4	2.0	7.2	8.0	94.9	37.69	....	7.24	14.01	4.41	14.88	2.09	6.43	16.73	103.48
E. SE	30.6	26.8	20.3	14.4	25.1	22.7	5.0	1.0	2.0	147.9	75.96	....	23.20	18.65	29.44	25.55	5.08	1.53	11.05	190.46
SE. by E	16.8	41.1	18.0	20.6	12.0	33.1	8.0	5.1	8.0	162.7	55.29	....	18.20	30.20	12.12	59.67	16.45	21.53	20.32	233.78
SE	47.5	69.1	71.0	48.5	64.1	30.0	23.9	12.3	8.0	374.4	141.16	....	78.38	54.84	109.55	35.06	45.07	39.38	17.43	520.87
SE. by S	21.1	6.4	6.8	11.3	10.0	8.3	30.9	27.6	11.0	133.4	60.02	....	9.81	12.48	12.62	7.68	53.32	69.37	21.22	246.52
S. SE	7.4	2.6	2.2	7.2	6.0	7.3	18.9	29.6	19.9	101.1	20.78	....	0.81	8.97	4.91	4.31	16.45	82.22	24.50	162.95
S. by E	4.2	3.9	2.2	2.1	8.0	3.1	20.9	18.4	11.0	73.8	8.33	....	1.86	0.20	4.31	2.77	27.82	38.56	11.05	94.90
South	26.4	6.4	10.1	14.4	6.0	13.4	19.9	6.1	7.0	109.7	55.92	....	6.37	14.11	3.00	20.79	27.32	4.59	6.67	138.77
S. by W	7.4	6.4	3.4	15.5	6.0	12.4	16.0	6.1	10.0	83.2	15.30	....	2.87	22.57	1.70	14.36	25.33	8.97	9.66	100.76
S. SW	14.7	6.4	22.5	38.2	15.0	32.1	43.9	24.5	15.9	213.2	38.74	....	31.58	71.33	16.42	62.98	84.99	44.07	17.03	367.14
SW. by S	13.7	3.9	30.4	43.3	20.1	28.0	40.9	10.2	28.8	219.3	40.61	....	70.30	83.09	19.22	50.78	64.85	21.43	38.94	389.28
SW	24.3	35.8	45.0	116.4	30.1	34.1	32.9	8.2	113.5	440.3	78.58	....	67.10	197.84	40.36	55.95	47.88	19.69	202.66	710.06
SW. by W	7.4	15.4	23.7	26.8	24.1	28.0	23.9	7.2	73.7	230.2	26.90	....	56.21	54.84	32.84	43.33	60.65	14.59	197.09	486.45
W. SW	9.5	20.5	37.1	20.6	17.0	37.2	41.9	40.8	56.8	281.4	28.69	....	91.39	36.38	22.62	68.46	76.22	92.52	123.49	540.77
W. by S	18.0	18.0	19.1	15.5	11.0	39.3	25.9	48.0	26.8	221.6	51.04	....	31.03	21.02	13.32	51.30	42.48	116.49	22.11	348.79
West	26.4	49.3	18.0	10.3	14.0	22.7	38.9	25.5	13.0	218.1	69.81	....	36.71	14.32	17.42	25.96	92.56	57.43	19.72	333.93
W. by N	20.0	34.6	3.4	5.2	11.0	99.7	39.9	42.9	10.0	186.7	41.97	....	10.39	11.44	17.32	17.99	86.69	103.95	12.86	302.61
W. NW	25.4	30.6	12.4	7.2	13.0	14.4	36.9	51.1	28.8	219.8	56.92	....	27.28	14.63	11.62	18.20	84.08	131.39	47.21	391.33
NW. by W	7.4	19.2	6.8	6.2	7.0	15.5	21.9	16.3	17.9	118.2	21.54	....	15.37	13.90	10.21	32.16	49.27	35.19	15.23	192.87
NW	28.5	38.4	18.0	25.8	16.0	21.7	21.9	33.7	22.9	226.9	59.48	....	22.66	48.86	11.02	34.95	15.26	34.56	44.31	271.10
NW. by N	16.8	5.1	3.4	9.3	7.0	15.5	3.0	20.4	19.9	100.4	31.98	....	9.61	7.73	5.41	22.33	1.10	24.79	41.92	144.87
N. NW	12.6	10.3	11.2	14.4	7.0	16.5	6.0	28.6	11.0	117.6	23.01	....	17.51	12.27	5.41	31.61	2.49	31.93	11.86	136.12
N. by W	10.5	5.1	0.0	12.4	15.0	29.0	1.0	30.6	0.0	103.6	11.92	....	0.00	19.07	14.82	60.70	1.20	45.59	0.00	153.30
Calm	49.5	19.6	110.4	99.0	119.2	81.7	127.7	140.8	124.4	872.3	....	....	....	....	....	....	....	....	....	....
Sums	730.0	730.0	730.0	730.0	730.0	730.0	730.0	730.0	730.0	6570.0	1846.74	....	1058.58	1113.68	999.47	1040.13	1130.39	1219.09	1108.64	9516.72

TABLE Q.—*Mean comparative duration, amount, and relative velocity of the wind for the several points of the compass for the seasons of* 1861, *at Milwaukee, Wisconsin.*

Points.	DURATION OF WIND.					AMOUNT OF WIND.					VELOCITY OF WIND.				
	Spring.	Summer.	Autumn.	Winter.	Year.	Spring.	Summer.	Autumn.	Winter.	Year.	Spring.	Summer.	Autumn.	Winter.	Year.
North	22.5	21.9	8.1	2.0	15.2	....	34.31	19.91	2.49	30.27	....	1.540	2.080	1.25	1.78
N. by E	36.0	53.5	19.5	2.0	32.6	....	158.95	61.43	0.70	99.03	....	2.960	3.420	0.35	2.84
N. NE	57.9	61.7	19.7	14.0	41.5	....	152.87	51.44	36.55	106.48	....	2.576	2.560	2.62	2.75
NE. by N	23.1	11.7	14.9	13.0	15.4	....	21.57	31.22	27.98	35.52	....	1.553	1.743	2.16	1.92
NE	27.0	26.5	10.9	17.9	21.6	....	47.33	15.11	38.45	34.97	....	1.556	1.233	2.15	1.67
NE. by E	11.2	8.7	8.2	15.9	9.9	....	14.87	11.17	34.16	16.56	....	1.666	1.363	2.14	1.66
E. NE	32.4	3.8	16.7	13.9	15.6	....	4.70	19.85	34.95	29.06	....	1.240	1.233	2.51	1.59
E. by N	16.3	4.4	3.8	1.0	6.5	....	3.42	4.37	0.10	7.48	....	0.596	.700	0.10	0.79
East	23.2	11.8	3.7	2.0	10.6	....	6.32	2.44	0.20	10.08	....	0.596	.690	0.10	0.80
E. by S	19.9	14.9	7.5	8.0	10.5	....	8.55	7.80	16.73	12.92	....	0.746	1.020	2.10	0.95
E. SE	28.7	19.9	9.6	2.0	16.4	....	23.76	10.72	11.05	23.56	....	1.206	1.213	5.55	1.91
SE. by E	28.9	16.9	15.4	8.0	18.1	....	20.17	32.55	20.32	29.22	....	1.160	2.693	2.55	2.17
SE	58.3	61.2	22.1	8.0	41.6	....	80.92	39.84	17.43	65.11	....	1.313	2.090	2.21	1.92
SE. by S	13.8	9.4	22.3	11.0	14.8	....	11.64	43.46	21.22	30.82	....	1.270	1.730	1.94	1.72
S. SE	5.0	5.1	18.6	19.9	11.2	....	4.90	34.33	24.50	20.37	....	0.803	1.413	1.23	1.59
S. by E	4.1	4.1	14.1	11.0	8.2	....	2.12	23.03	11.05	11.86	....	0.440	1.443	1.01	1.09
South	16.4	10.2	13.1	7.0	12.2	....	7.83	17.57	6.67	17.35	....	.700	1.223	0.96	1.11
S. by W	6.9	8.3	11.5	10.0	9.2	....	9.05	16.22	9.66	12.59	....	.856	1.406	0.97	1.23
S. SW	10.6	25.2	33.5	15.9	23.7	....	39.78	64.01	17.03	45.89	....	1.453	1.893	1.07	1.72
SW. by S	8.8	31.3	26.4	28.8	24.4	....	57.54	45.69	38.94	48.65	....	1.733	1.836	1.35	1.88
SW	30.0	63.8	25.1	113.5	48.9	....	101.77	41.17	202.66	88.78	....	1.510	1.856	1.79	1.89
SW. by W	11.4	24.9	19.7	73.7	25.6	....	47.96	39.52	197.09	60.81	....	1.930	2.040	2.67	2.28
W. SW	15.0	24.9	40.0	56.8	31.3	....	50.13	79.07	123.49	67.57	....	1.850	1.980	2.18	2.09
W. by S	18.0	15.2	37.7	26.8	24.6	....	21.79	70.09	22.11	43.60	....	1.396	1.796	0.82	1.66
West	37.9	14.1	29.0	13.0	24.2	....	22.82	58.65	19.72	41.74	....	1.556	1.923	1.52	1.83
W. by N	27.3	9.9	34.2	10.0	20.7	....	13.05	69.54	12.86	37.83	....	2.296	1.840	1.29	1.97
W. NW	28.0	10.9	34.1	28.8	24.4	....	17.84	77.89	47.21	48.92	....	1.340	2.050	1.63	1.76
NW. by W	13.3	6.7	17.9	17.9	13.1	....	13.16	38.87	15.23	24.11	....	1.993	2.160	0.85	2.02
NW	33.4	19.9	25.8	22.9	25.2	....	27.51	28.26	44.31	33.89	....	1.280	1.113	1.94	1.40
NW. by N	11.0	6.6	13.0	19.9	11.1	....	7.58	16.07	41.92	18.11	....	1.476	1.006	2.11	1.43
N. NW	11.4	10.8	17.0	11.0	13.1	....	11.73	22.02	11.86	17.02	....	1.053	1.146	1.01	1.18
N. by W	7.8	9.1	20.2	0.0	11.6	....	11.30	35.83	0.00	19.16	....	0.840	1.506	0.00	1.06
Calm	34.5	109.5	116.7	124.4	96.9	....	....	....	....	....	....	....	....	....	....
Sums	730.0	730.0	730.0	730.0	730.0	....	1057.93	1190.50	1108.64	1180.33	....	44.590	50.488	59.13	50.08
Means												[illegible]	[illegible]	[illegible]	[illegible]

TABLE R.—*Reduction of the winds to the four cardinal points of the compass, September,* 1861, *Milwaukee, Wis.*

Points in degrees.	North.		East.		South.		West.	
	Duration.	Amount.	Duration.	Amount.	Duration.	Amount.	Duration.	Amount.
Due	10. 00	14. 500	3. 00	2. 200	13. 00	20. 100	22. 00	25. 100
11 +	35. 31	100. 062	7. 02	19. 892	11. 77	13. 635	2. 34	2. 711
22 +	27. 72	56. 724	11. 48	23. 496	28. 64	56. 262	11. 86	23. 304
33 +	6. 65	7. 734	4. 45	5. 167	22. 45	40. 827	15. 00	27. 276
45	12. 02	20. 928	12 02	20. 928	23. 33	38. 259	23. 33	38. 259
56 +	6. 12	8. 560	9. 15	12. 811	15. 00	23. 276	22. 45	34. 840
67 +	8. 80	9. 411	21. 25	22. 730	13. 88	25. 323	33. 26	61. 158
78 +	1. 56	1. 989	7. 85	10. 006	7. 41	9. 673	37. 27	48. 645
78 +	3. 71	3. 394	12. 75	14. 125	2. 54	2. 808	18. 64	17. 068
67 +	5. 36	6. 739	20. 33	22. 823	8. 42	9. 449	12. 94	16. 261
56 +	8. 34	17. 282	26. 61	47. 983	17. 78	32. 058	12. 48	25. 865
45	14. 85	23. 898	20. 50	23. 967	20. 50	23. 967	14. 85	23. 898
33 +	12. 48	17. 961	4. 45	4. 167	6. 65	6. 237	8. 34	11. 999
22 +	14. 78	28. 274	2. 68	1. 569	6. 47	3. 788	6. 13	11. 710
11 +	27. 47	57. 553	0. 59	0. 529	2. 94	2. 649	5. 48	11. 458
Sums	195. 17	375. 009	164. 13	273. 795	200. 78	308. 311	246. 37	379. 552

TABLE S.—*Resultant direction, mean progress, and mean relative velocity of the wind for the several months of* 1861, *Milwaukee, Wis.*

Months.	From the duration.		From the amount.	
	Wind, from whence.	Mean progress.	Wind, from whence.	Mean relative velocity.
	° ′ ″		° ′ ″	
April	N. 41 23 07 E	0. 190	N. 47 14 35 E	2. 74
May	N. 20 36 30 E	0. 163		
June	N. 3 35 17 E	0. 030	N. 39 58 52 W	1. 71
July	S. 39 42 13 W	0. 267	S. 75 57 32 W	1. 76
August	N. 37 05 52 E	0. 185	N. 29 16 32 E	1. 76
September	S. 86 05 52 W	0. 141	N. 57 45 43 W	1. 63
October	S. 56 04 09 W	0. 216	S. 69 30 27 W	1. 86
November	N. 79 19 18 W	0. 256	S. 87 02 56 W	2. 07
December	S. 61 37 20 W	0. 349	S. 62 32 35 W	1. 86
Year	S. 80 17 43 W	0. 095	N. 76 36 45 W	1. 71
Year omitting April	S. 75 10 35 W	0. 123	N. 87 24 54 W	1. 57

TABLE U.—*Storms during the different months of* 1861 *at Milwaukee, W*

Date.	Wind, from whence.	Duration hours.	Relative velocity.			Date.	Wind, from whence.	Duration hours.	Relative velocity.		
			Maximum.	Minimum.	Mean.				Maximum.	Minimum.	Mean.
April 4	E. SE	9	5.0	3.7	4.11	Aug. 13	N. NE	3	4.2	4.0	[illegible]
6	SE	13	6.8	3.9	5.02	Sept. 15	N. NE	4	4.8	4.2	[illegible]
8, 9	N. NE	9	4.7	3.9	4.21	18	S. SW	3	4.3	4.0	[illegible]
9	N. NE	7	4.0	3.4	3.93	20	North	4	6.3	4.2	[illegible]
11	N. NE	3	4.2	4.1	4.13	22	W. SW	3	5.0	4.2	[illegible]
15, 16	N. NE	36	5.7	3.4	4.53	Oct. 2	W. SW	5	5.2	4.0	[illegible]
17	S. SE	4	5.8	4.5	5.12	11	W. SW	7	4.2	3.4	[illegible]
18	N. NW. to N	8	5.8	4.1	4.95	12	W. NW	9	5.0	3.6	[illegible]
20	SW	9	5.5	4.0	4.94	14	N. NE	4	5.0	4.2	[illegible]
22	SW. to W	6	5.5	3.8	4.65	17, 18	N. NE. to N	17	6.0	3.7	[illegible]
23	N. NE	3	5.0	4.1	4.53	19	W. NW	4	4.8	4.2	[illegible]
24	SW. to W	17	6.7	3.8	5.21	29	SW	5	5.8	3.9	[illegible]
25	SE	3	4.3	3.6	4.00	30	West	3	4.3	4.0	[illegible]
26	SE. to S	5	5.0	3.6	4.42	Nov. 2	N. NE	14	6.2	3.8	[illegible]
26	South	4	5.8	4.5	5.12	10	S. SW	5	4.4	3.9	[illegible]
30	NW. to W.NW.	8	5.8	4.1	4.95	19	SE. to S. SE	21	6.5	3.7	[illegible]
June 14	SW	15	6.3	3.6	5.71	22	W. SW	4	4.7	4.1	[illegible]
15	SW. to W	14	9.2	4.0	6.54	25	W. NW	3	4.3	3.5	[illegible]
16	N. NE	10	6.6	4.0	5.34	27	W. NW	6	5.2	4.0	[illegible]
July 1	N. to N. NE	10	6.2	4.4	5.41	28, 29	W. NW. to N	4	4.5	4.3	[illegible]
10	North	7	4.4	3.0	4.00	29, 30	W. NW	7	4.9	3.5	[illegible]
12	North	11	5.5	4.0	4.76	Dec. 10	N. to NW	11	6.3	4.0	[illegible]
25	SW	3	4.2	3.6	3.87	14	N. NE	3	4.1	3.9	[illegible]
28	NW	6	5.0	4.0	4.37	16	W. SW	9	5.5	3.8	[illegible]
Aug. 10	N. NE	8	4.5	3.7	4.33	20	NE	3	4.2	3.8	[illegible]
11	N. NE	8	5.7	4.8	5.06	22, 23	E. SE. to E. NE.	11	6.5	3.8	[illegible]
12	N. NE	12	6.8	4.0	5.71	26, 27	SW	17	8.0	3.9	[illegible]
12	NE	7	4.0	3.6	3.93						

TABLE V.—*Storms in the year* 1861, *Milwaukee, Wis.; compiled by the direction.*

Date.	Wind, from whence.	Duration hours.	Relative velocity.			Date.	Wind, from whence.	Duration hours.	Relative velocity.		
			Maximum.	Minimum.	Mean.				Maximum.	Minimum.	Mean.
July 10	North	7	4.4	3.0	4.00	April 26	South	4	5.8	4.5	[illegible]
12	North	11	5.5	4.0	4.76	Sept. 18	S. SW	3	4.3	4.0	[illegible]
Sept. 20	North	4	6.3	4.2	5.67	Nov. 10	S. SW	5	4.4	3.9	[illegible]
July 1	N. to N. NE	10	6.2	4.4	5.41	April 20	SW	9	5.5	4.0	[illegible]
Oct. 17, 18	N. NE. to N	17	6.0	3.7	5.05	June 14	SW	15	6.3	3.6	[illegible]
April 8, 9	N. NE	9	4.7	3.9	4.21	July 25	SW	3	4.2	3.6	[illegible]
9	N. NE	7	4.0	3.4	3.93	Oct. 29	SW	5	5.8	3.9	[illegible]
11	N. NE	3	4.2	4.1	4.13	Dec. 26, 27	SW	17	8.0	3.9	[illegible]
15, 16	N. NE	36	5.7	3.4	4.53	April 22	SW. to W	6	5.5	3.8	[illegible]
23	N. NE	3	5.0	4.1	4.53	24	SW. to W	17	6.7	3.8	[illegible]
June 16	N. NE	10	6.6	4.0	5.34	June 15	SW. to W	14	9.2	4.0	[illegible]
Aug. 10	N. NE	8	4.5	3.7	4.33	Sept. 22	W. SW	3	5.0	4.2	[illegible]
11	N. NE	8	5.7	4.8	5.06	Oct. 2	W. SW	5	5.2	4.0	[illegible]
12	N. NE	12	6.8	4.0	5.71	11	W. SW	7	4.2	3.4	[illegible]
13	N. NE	3	4.2	4.0	4.10	Nov. 22	W. SW	4	4.7	4.1	[illegible]
Sept. 15	N. NE	4	4.8	4.2	4.45	Dec. 16	W. SW	9	5.5	3.8	[illegible]
Oct. 14	N. NE	4	5.0	4.2	4.67	Nov. 23	W. SW. to W	21	5.1	4.0	[illegible]
Nov. 2	N. NE	14	6.2	3.8	4.67	Oct. 30	West	3	4.3	4.0	[illegible]
Dec. 14	N. NE	3	4.1	3.9	4.00	Dec. 10	W. to NW	11	6.3	4.0	[illegible]
Aug. 12	NE	7	4.0	3.6	3.93	Oct. 12	W. NW	9	5.0	3.6	[illegible]
Dec. 20	NE	3	4.2	3.8	4.03	19	W. NW	4	4.8	4.2	[illegible]
22, 23	E. SE to E. NE.	11	6.5	3.8	4.64	Nov. 25	W. NW	3	4.3	3.5	[illegible]
April 4	E. SE	9	5.0	3.7	4.11	27	W. NW	6	5.2	4.0	[illegible]
6	SE	13	6.8	3.9	5.02	29, 30	W. NW	7	4.9	3.5	[illegible]
25	SE	3	4.3	3.6	4.00	28, 29	W. NW to NW.	4	4.5	4.3	[illegible]
Nov. 19	SE. to S. SE	21	6.5	3.7	4.87	April 30	NW. to W.NW.	8	5.8	4.1	[illegible]
April 26	SE. to S	5	5.0	3.6	4.00	July 28	NW	6	5.0	4.0	[illegible]
17	S. SE	4	5.8	4.5	5.12	April 18	N. NW. to N	8	5.8	4.1	[illegible]

TABLE W.—*Showing rain and snow, with different winds, at Milwaukee, for the years* 1861, 1862, 1863, *and* 1864.

Day of month.	Amount of rain, &c., in inches.	Direction of wind.	Mean relative velocity.
1861.			
April 1	0.53		
3	0.09	N.NW	
4	0.07	E.NE	
5	1.04	E.NE	
7	0.78	S.SE	
10	0.08	NE. by N	
12	0 06	N.NE	
16	0.30	N.NE	
17	0.02	SE. by S	
21	0.14	SW	
22	0.22	SW	
26	0.32	SE	
June 1	0.30		
3	0.82	NW	
10	0.01	SE	
19	0.05	S.SW	
24	0.38	SE	
29	0.24	SE. to N	
30	0.10	N.NE	
July 4	2.02	South	
7	0.24	SW	
8	0.12	West	
11	0.58	N. by E	
13	0.01	North	
16	0.12	SW	
18	0.29	SW	
23	0.06	SE. to SW	
25	0.27	SE	
26	1.04	SW	
28	0.02	Calm	
Aug. 6	0.78	NE	
7	0.64	NE	
11	0 63	NE	
18	0.01	SE. to NW	
20	0.15	N.NE	
31	0.76	S.SW	
Sept. 1	0.25	SW	
6	0.02	North	
9	0.53	SE	
10	0.03	NW	
12	0.57	SW	
15	0.08	NE	
19	0.94	N.NE	
24	0.18	SW	
26	0.02	West	
28	0.01	SW	
30	0.23	North	
Oct. 1	0.03	SE	
2	0.63	NE	
3	0.06	NE	
9	0.11	SE	
21	0.01	SE	
28	0.29	South	
31	0.08	West	
Nov. 4	0.06	SW	
18	0.86	SE	
20	0.15	SE	
21	0.10	SE	
22	0.08	W.SW	
25	0.04	N.NW	
27	0.04	S. by E	
29	0.18	W.NW	
Dec. 5	0.31	SW	
6	0.37	SW	
21	0.85	Calm	
22	0.02	East	
1862.			
Jan. 2	0.45	NW	2.3
7	0.12	W.SW	0.2
10	0.21	NW	2.5
11	0.16	SW	1.0
14	0.22	E.SE	2.0
16	0.17	Calm	
1862.			
Jan. 17	0.12	Calm	
18	0.36	South	0.2
19	0.57	NW	2.0
24	0.03	W.NW	0.8
26	0.75	Calm	0.5
28	0.21	West	0.3
30	0.04	Calm	
Feb. 1	0 01	West	1.5
5	0.14	S.SW. to S.SE	0.5
10	0.10	S.SW	1.5
18	0.10	W. to W.SW	1.8
20	0.07	W.NW. to W	0.3
23	0.06	W.SW. to N.NE.	0.9
Mar. 1	0.40	W.NE. to E.NE	1.5
2	0.01	NE	3.6
8	0.48	S.SW	1.0
14	0.42	N.NE	5.5
19	0.71	E.NE	2.9
22	0.02	N.W	0.2
27	0.05	Calm	
29	0.01		
31	0.14		
April 1	0.53		
3	0.25		
7	0.88		
11	0.74		
14	0.14		
15	2.26	E.SE	
16	0.20	South	4.5
26	0.20	N.NE	1.0
30	0.76	SE	0.5
May 12	0.08	SW	1.4
15	0.18	E.SE	0.4
16	0.57	West	0.2
17	0.58	NE	0.9
20	1.12	NE	0.5
25	0.30	S.SW	1.6
29	0.90	E.SE. to NE	0.4
30	0.62	NE	1.9
June 11	1.08	SW	1.4
12	0.16	N.NE	2.2
13	0.41	N.NE	1.0
15	0.48	NE	3.0
16	0.09	E.SE	2.1
17	0.02	SW	2.9
19	0.86	NW	0.5
27	0.76	E.SE	0.5
July 7	1.19	NW	0.6
8	0.19	SW	0.6
12	0.06	SW	1.2
17	0.40	NE	0.9
18	1.10	SE	0.4
19	1.14	West	0.9
27	0.01	SW	1.2
Aug. 2	0.20	SE	0.5
3	0.90	SW	0.5
4	0.15	SE. to W.NW	0.6
8	0.05	W.NW	0.5
10	0.16	SE	0.4
13	0.57	Calm	
19	0.04	SE	0.5
30	0.87	SW	0.8
Sept. 3	0.35	S.SW	2.1
4	0.55	SW	1.8
5	0.41	Calm	
10	0.59	W.SW	0.8
15	1.35	NE	3.4
16	0.42	E.SE	0.4
22	0.64	SW	1.3
27	0.72	N.NE	0.9
29	0.37	NE	2.5
30	1.40	NE	0.2
Oct. 5	1.04	S.SE	1.5

Rain and snow with different winds, &c.—Continued.

Day of month.	Amount of rain, &c., in inches.	Direction of wind.	Mean relative velocity.	Day of month.	Amount of rain, &c., in inches.	Direction of wind.	Mean relative velocity.
1862.				1863.			
Oct. 6	0.13	SW	2.2	Aug. 9	0.02	W.SW	0.2
7	0.46	SW	3.5	12	0.05	SE	0.6
14	0.13	N.NE	2.5	14	0.28	NE	1.4
22	0.04	NW	2.2	21	0.15	SW	1.4
23	0.06	NW	1.4	22	0.55	SW	1.8
Nov. 1	0.14	NE	2.1	23	0.35	SE	1.2
4	0.04	S.SW	1.3	26	0.15	W.SW	1.5
5	0.04	North	3.5	Sept. 6	0.10	S.SE	0.5
10	0.28	SW	0.8	9	0.44	E.NE	1.4
13	0.05	W.SW	0.1	16	0.42	S.SW	2.2
15	0.50	Calm		20	0.06	N.NE	1.4
26	0.07	SW	2.1	30	0.04	West	2.0
29	0.16	S.SW	0.6	Oct. 1	0.16	W.NW	1.6
Dec. 12	0.39	E.SE	0.7	2	0.08	West	1.5
14	0.09	West	1.3	3	0.33	SE. to W.NW	3.4
20	0.04	S.SE	1.8	7	0.04	SW	1.0
23	0.31	E.SE	1.8	16	0.35	E.NE	0.1
25	0.54	W.SW	0.4	21	0.57	NW	0.9
1863.				23	0.02	W.NW	2.6
Jan 1	0.26	S.SW	4.3	28	1.10	S.SE	0.9
2	0.70	S.SW	3.8	29	0.28	SE	2.2
4	0.13	SW	2.5	Nov. 1	0.15	SE	2.7
12	0.77	E.NE	1.0	3	1.93	S.SW	1.1
14	0.02	W.NW	2.4	12	0.50	S.SW	0.3
18	0.66	S.SW	0.9	13	0.05	East	2.8
22	0.73	Calm		14	0.39	N.NW	2.8
28	0.06	W.SW	0.4	18	0.08	S.SW	1.4
Feb. 4	0.20	Calm		23	0.34	E.NE.	3.2
8	0.56	East	0.8	28	0.07	N.NW	3.1
13	0.58	S.SE	0.9	Dec. 9	0.18	N.NW to SE	1.6
18	0.15	Calm		12	1.15	N.NE	2.8
25	0.36	N.NW	0.1	16	0.98	E.NE	5.3
Mar. 1	0.70	W.NW	0.2	17	0.02	E.NE	3.3
4	0.03	Calm		25	0.22	South	0.1
7	0.04	Calm		26	1.19	E.SE. to E.NE	2.2
10	0.03	W.NW	0.5	27	0.05	E.NE	3.9
16	0.02	SE	0.1	30	0.78	N.NW	1.9
19	0.50	E.SE	1.4	1864.			
21	0.51	Calm		Jan. 3	0.11	W.SW	1.2
22	0.64	SE	0.5	13	0.14		
28	0.01	N.NE. to N.NW	3.1	29	1.00	NE	3.0
April 9	0.23	S.SE	1.6	30	0.90	Calm	
17	0.23	SE	0.9	Feb. 4	0.19	NW	1.2
19	0.43	NE	1.1	23	0.01	West	2.3
20	0.07	NE	1.9	25	0.22	N.NW	0.1
21	0.08	SE	1.4	Mar. 3	0.23	S.SW	1.4
May 2	0.32	NE	2.8	9	0.76	NE	2.0
3	0.56	NE	2.1	10	0.56	N.NE	1.5
4	0.71	NE	2.7	27	0.92	N.NE	2.5
9	0.75	NE	1.1	28	0.05	E.SE	0.9
10	0.90	SW. to N.NE	2.0	April 3	0.48	N.NE	1.3
12	0.01	NW	0.9	4	0.04	N.NE. to N.NW	3.5
21	0.36	S.SE	1.0	6	0.18	N.NE	1.8
22	0.06	SE	0.7	7	0.57	East	0.1
24	0.06	W.NW	0.5	10	0.73	NW	1.9
27	0.07	NE	2.5	12	0.11	W.NW	2.0
28	0.92	NE	1.5	21	0.15	N.NE	0.2
29	0.25	SE	0.6	23	0.24	NE	3.5
30	0.24	NNW	1.1	24	0.26	N.NE	3.5
June 4	0.04	NE	1.0	28	0.25	E.SE	0.5
20	0.03	W.NW	1.6	30	0.01	N.NE	0.7
22	0.14	SE	0.8	May 5	0.44	SW	2.5
28	0.58	SE	0.7	7	2.26	N. to NE	0.9
July 1	0.01	SW	0.9	11	0.01	South	0.8
18	0.96	SE	1.3	22	0.01	Calm	0.5
23	0.20	W.NW	1.9	24	0.01	W.SW	0.4
24	0.25	NE	0.8	31	0.03	North	1.5
27	0.15	NW	1.7	June 30	0.62	N.NE	1.1
28	0.01	NW	1.3	July 4	0.14	S.SE	0.1
30	0.47	NE	0.1	6	0.58	N.NE	0.8
30	0.36	SE	1.2	7	0.13	W.NW	1.7
Aug. 4	0.50	S.SW	1.3	16	1.47	E.SE	0.9
6	0.21	S.SE	0.2	17	3.20	S.SE	1.6
7	0.36	W.SW	0.2	18	0.51	South	1.2

Rain and snow with different winds, &c.—Continued.

Day of month.	Amount of rain, &c., in inches.	Direction of wind.	Mean relative velocity.	Day of month.	Amount of rain, &c., in inches.	Direction of wind.	Mean relative velocity.
1864.				1864.			
July 30	0.42	SW	0.6	Oct. 27	0.17	S.SW	1.6
Aug. 10	0.15	W.SW	1.2	Nov. 3	0.29	N.NW	0.7
11	0.08	S.SW	0.5	5	0.12	S.SE	0.9
22	0.38	SE	0.7	7	0.02	N.NE	2.5
Sept. 2	0.23	N.NE	2.0	13	0.52	Calm	......
3	0.42	NE	2.4	24	0.50	Calm	......
6	0.41	E.SE	2.3	26	0.02	W.SW	0.3
8	0.15	SW	1.6	27	0.04	SW	0.5
12	0.78	SE	1.6	Dec. 1	0.60	E.SE	1.1
13	0.14	SE	1.8	4	0.30	E.SE	0.2
16	0.09	Calm	......	6	0.23	Calm	......
21	0.02	South	1.1	9	0.03	E.SE	0.2
22	0.23	South	2.7	10	0.12	W.SW	0.1
28	0.39	N.NE	1.1	12	0.05	S.SE	0.6
29	0.07	N.NE	1.7	14	0.18	Calm	......
Oct. 4	0.41	SW	0.8	15	0.02	Calm	......
5	0.06	W.SW	1.0	17	0.16	NW	1.3
6	0.06	SW	1.3	20	0.13	SW	1.9
16	0.07	West	0.4	25	0.09	South	1.3
20	0.26	NE	0.8	27	0.08	W.SW	2.3
25	0.60	SE	0.6				

TABLE X.—*Showing the evaporation and humidity for different winds at Milwaukee, for* 1862, 1863, *and* 1864.

Year and day of month.	Mean temperature.	Mean humidity.	Mean evaporation.	Mean cloudiness.	Direction of wind.	Relative velocity.	Year and day of month.	Mean temperature.	Mean humidity.	Mean evaporation.	Mean cloudiness.	Direction of wind.	Relative velocity.
1862.							1862.						
May 1	45	.770	.019	8	W. SW	0.3	June 2	54	.512	.235	5	N. NE	5.2
2	44	.744	.059	7	N. NE	1.0	3	51	.572	.168	3	N. NE	5.2
3	53	.673	.139	0	SE	0.3	4	55	.420	.232	0	N. NE	4.1
4	50	.477	.100	3	N. NE	1.5	5	58	.493	.175	2	N. NE	1.9
5	46	.614	.137	0	N. NE	2.0	6	63	.530	.217	2	N. NE	2.6
6	49	.493	.188	0	E. SE	0.1	7	54	.506	.215	0	N. NE	3.3
7	55	.638	.191	0	N. NW	0.5	8	56	.584	.193	0	N. NE	0.8
8	55	.816	.165	0	E. SE	0.4	9	70	.452	.275	0	West	1.3
9	66	.435	.244	0	Calm	0.0	10	73	.462	.290	2	West	0.8
10	65	.573	.202	0	N. NW	0.8	11	77	.481	.395	4	S. SW	1.4
11	58	.454	.268	0	E. SE	0.4	12	71	.446	.174	5	W. NW	2.2
12	72	.517	.214	2	SW	1.4	13	54	.844	.160	8	N. NE	1.0
13	54	.715	.281	8	N. NE	3.1	14	53	.932	.085	10	N. NE	2.6
14	48	.755	.115	5	N. NE	0.8	15	53	.710	.210	5	NE	3.0
15	57	.692	.146	0	E. SE	0.4	16	59	.638	.145	7	E. SE	2.1
16	65	.464	.187	5	E. SE	0.2	17	70	.737	.155	6	SW	2.9
17	61	.453	......	6	N. NE	0.9	18	52	.816	.050	8	N. NE	2.6
18	45	.762	.059	10	N. NW	1.4	19	55	.703	.230	1	E. SE	0.5
19	40	.706	.141	3	East	0.3	20	64	.701	.058	9	West	1.1
20	46	.571	.220	3	NE	0.5	21	61	.706	.195	4	N. NE	1.0
21	46	.894	.232	10	NE	2.5	22	55	.745	.175	7	N. NE	1.4
22	62	.580	......	0	SW	1.8	23	57	.742	.080	7	N. NE	1.3
23	49	.649	.143	4	NE	0.7	24	61	.667	.200	0	NE	0.3
24	50	.481	.161	0	E. SE	0.2	25	63	.686	.200	0	East	0.2
25	62	.461	.164	4	S. SW	1.6	26	65	.767	.220	3	E. SE	0.3
26	68	.587	.240	3	SW	3.8	27	65	.819	.220	7	E. SE	0.5
27	49	.531	.075	7	N. NE	4.6	28	64	.871	.075	4	NE	0.8
28	48	.540	.187	0	N. NE	2.0	29	76	.641	.215	1	West	1.2
29	52	.580	......	6	East	0.4	30	58	.826	.220	1	N. NE	2.5
30	49	.889	......	10	N. NE	1.9	July 1	67	.566	.274	5	South	0.9
31	47	.892	.045	10	N. NE	1.6	2	64	.725	.193	0	Calm	0.0
June 1	55	.536	.080	3	N. NE	1.6	3	68	.618	.098	6	S. SE	0.9

Showing the evaporation and humidity for different winds, &c.—**Continued.**

Year and day of month.	Mean temperature.	Mean humidity.	Mean evaporation.	Mean cloudiness.	Direction of wind.	Relative velocity.
1862.						
July 4	78	.628	.260	4	South	1.5
5	83	.684	.335	0	SW	1.6
6	76	.642	.300	3	N. NE	0.8
7	76	.789	.095	8	W. NW	0.6
8	73	.800	.225	5	South	0.6
9	67	.808	.140	5	N. NE	1.1
10	65	.580	.190	2	N. NE	0.9
11	71	.665	.240	7	East	0.2
12	69	.657	.250	4	SW	1.2
13	72	.775	.040	5	W. SW	0.6
14	72	.758	.250	5	South	0.6
15	70	.700	.180	5	W. NW	1.0
16	58	.785	.075	10	N. NE	2.1
17	62	.829	.020	10	NE	0.9
18	66	.892	.025	10	SE	0.4
19	77	.717	.240	5	West	0.9
20	73	.559	.205	4	NW	0.8
21	73	.730	.220	4	East	0.8
22	75	.766	.225	4	W. NW	1.0
23	72	.582	.295	3	W. NW	2.2
24	69	.620	.215	2	N. NW	1.3
25	68	.751	.210	4	Calm	0.0
26	71	.618	.260	1	S. SE	0.8
27	76	.602	.230	3	SW	1.2
28	77	.634	.330	0	W. NW	2.1
29	70	.660	.280	1	N. NW	0.8
30	71	.738	.200	0	East	0.5
31	72	.750	.390	0	East	0.4
Aug. 1	74	.626	.265	7	East	0.4
2	72	.615	.195	4	SE	0.5
3	75	.728	.155	4	West	0.5
4	72	.845	......	7	S. SE	0.6
5	66	.794	.218	0	Calm	0.0
6	68	.797	......	7	Calm	0.0
7	84	.692	......	0	SW	0.4
8	87	.609	.108	3	W. NW	0.5
9	67	.829	......	5	N. NE	0.9
10	72	.657	.065	2	SE	0.4
11	75	.691	.250	2	West	0.9
12	67	.713	.210	0	Calm	0.0
13	69	.721	.050	7	SE	0.2
14	65	.856	.055	6	NE	0.5
15	61	.664	.190	0	East	0.5
16	64	.715	.200	0	SW	0.8
17	71	.643	.210	8	SW	1.5
18	65	.778	.230	0	NE	1.6
19	69	.655	.230	1	SE	0.5
20	73	.721	.170	1	SW	0.7
21	69	.696	.155	7	SE	0.4
22	70	.741	.160	4	W. NW	1.7
23	63	.724	.200	0	N. NE	2.7
24	66	.750	.175	5	East	1.2
25	76	.662	.245	3	SW	1.2
26	78	.673	.270	1	SW	1.0
27	70	.726	.215	2	N. NW	1.2
28	74	.694	.300	1	NW	1.9
29	66	.720	.210	4	N. NE	2.0
30	65	.783	.170	4	SE	0.8
31	72	.783	.165	6	SW	1.6
Sept. 1	59	.701	.145	3	N. NE	3.0
2	54	.706	.160	0	E. SE	0.8
3	71	.669	.230	0	S. SW	2.1
4	69	.782	......	6	SW	1.8
5	69	.884	......	10	Calm	0.0
6	60	.886	......	7	......	......
7	90	.804	.185	6	West	1.4
8	63	.658	.160	2	NW	1.2
9	62	.781	.155	1	SE	1.0
10	66	.820	.100	2	SE	0.8
11	69	.780	.140	10	SW	2.1
12	52	.601	.215	4	N. NE	2.6
13	57	.719	.125	6	SE	1.4
14	64	.837	.125	2	S. SE	0.7
1862.						
Sept. 15	59	.799	.110	7	NE	3.4
16	63	.867	.162	8	E. SE	0.4
17	65	.926	.163	10	South	0.2
18	57	.740	.055	3	W. NW	0.9
19	57	.802	.150	0	SE	0.5
20	66	.783	.180	0	West	0.7
21	69	.646	.170	0	S. SW	2.0
22	65	.695	.125	3	SW	1.3
23	63	.816	.030	4	West	2.2
24	53	.672	.110	0	West	0.4
25	56	.640	.200	0	SW	1.0
26	59	.737	.195	0	S. SW	0.8
27	62	.810	.125	0	S. SE	0.9
28	63	.729	.050	6	North	1.2
29	57	.798	.165	8	NE	2.5
30	59	.938	.100	10	NE	0.2
Oct. 1	62	.961	.110	10	SE	0.1
2	66	.865	.060	10	East	0.3
3	72	.847	.130	5	S. SW	2.1
4	56	.589	.200	0	W. NW	3.2
5	55	.752	.170	3	S. SE	1.5
6	68	.740	.145	10	SW	2.2
7	76	.778	.145	5	SW	3.5
8	63	.814	.125	9	SW	2.2
9	54	.760	.045	8	Calm	0.0
10	47	.749	.065	4	N. NW	0.9
11	43	.767	.065	0	East	0.2
12	47	.735	.060	0	South	0.7
13	52	.667	.105	1	SW	1.0
14	44	.654	.090	5	N. NE	2.5
15	45	.803	.010	9	West	0.5
16	49	.673	.120	1	NW	1.6
17	43	.775	.070	0	S. SE	0.8
18	64	.528	.135	1	West	2.9
19	44	.528	.075	0	N. NW	1.9
20	50	.670	.140	8	S. SW	3.1
21	52	.437	.125	2	W. NW	3.3
22	39	.518	.115	0	NW	2.2
23	44	.575	.015	10	East	1.4
24	39	.628	.105	10	W. NW	3.4
25	30	.709	.070	5	SW	2.2
26	33	.654	.070	3	SW	1.0
27	39	.619	.070	7	South	0.7
28	44	.614	.070	2	W. NW	1.8
29	46	.680	.065	3	SW	1.0
30	58	.530	.145	5	W. SW	2.0
31	59	.521	.150	0	SW	3.2
Nov. 1	43	.718	.025	10	NE	2.1
2	36	.758	.010	9	NW	1.6
3	38	.635	.090.	0	N. NE	1.6
1863.						
April 3	31	.778	.225	3	N. NE	3.0
4	36	.814	.080	0	SE	0.8
5	45	.634	.100	9	NE	1.2
6	38	.530	.100	3	NE	4.9
7	31	.601	.100	0	NE	3.4
8	35	.547	......	0	E. SE	1.4
9	42	.681	......	6	S. SE	1.6
10	51	.775	.030	10	S. SW	1.2
11	49	.688	.115	10	West	3.4
12	35	.676	.110	3	N. NE	2.7
13	39	.624	......	0	East	0.4
14	42	.623	......	7	NE	2.2
15	44	.524	.080	3	NE	1.1
16	46	.672	.120	0	East	0.4
17	47	.636	.140	0	SE	0.9
18	55	.690	.060	4	SE	2.1
19	48	.757	.235	4	SE	1.1
20	43	.889	.020	6	NE	1.9
21	45	.920	.180	10	SE	1.4
22	46	.885	.055	10	NE	2.2
23	55	.548	.150	3	N. NE	2.5
24	53	.600	.240	0	N. NE	4.2

Showing the evaporation and humidity for different winds, &c.—Continued.

Year and day of month.		Mean temperature.	Mean humidity.	**Mean evaporation.**	Mean cloudiness.	Direction of wind.	Relative velocity.	Year and day of month.		Mean temperature.	Mean humidity.	Mean evaporation.	Mean cloudiness.	Direction of wind.	Relative velocity.
1863.								1863.							
April	25	47	.515	.155	0	NE........	2.5	July	7	76	.632	.245	0	E. NE.....	0.8
	26	47	.611	.110	1	East.......	0.2		8	79	.651	.235	5	East.......	0.6
	27	50	.501	.140	7	NE........	0.3		9	71	.818	.040	10	North.....	0.2
	28	52	.459	.125	10	N. NE.....	4.6		10	76	.736	.170	8	W. NW....	0.2
	29	49	.457	.205	0	N. NE.....	4.8		11	60	.594	.115	10	NE.......	5.5
	30	52	.399	.170	0	E. NE.....	0.4		12	59	.688	.190	3	NE.......	4.2
May	1	61	.376	.320	2	South.....	0.9		13	63	.743	.210	0	E. SE.....	0.7
	2	44	.758	.090	4	NE.......	2.8		14	69	.570	.275	5	West......	2.3
	3	43	.860	.005	10	NE.......	2.1		15	61	.604	.130	1	East.......	1.4
	4	43	.915	.000	10	NE.......	2.7		16	60	.591	.200	1	SE........	1.0
	5	38	.834	.000	10	N. NE.....	5.9		17	60	.715	.190	0	E. NE.....	0.8
	6	48	.445	.215	2	NE.......	4.1		18	65	.582	.210	0	SE........	1.3
	7	51	.482	.215	0	N. NE.....	2.1		19	68	.802	.000	10	SE........	0.8
	8	64	.471	.280	3	W. NW....	1.1		20	64	.845	.170	7	NE.......	4.9
	9	50	.694	.095	7	NE.......	1.1		21	58	.735	.120	4	NE.......	4.0
	10	56	.865	.020	9	SW.......	2.0		22	64	.742	.150	2	SE........	0.8
	11	48	.913	.000	10	NE.......	1.1		23	74	.558	.295	0	W. NW....	1.9
	12	58	.642	.175	6	NW.......	0.9		24	67	.787	.000	9	NE.......	0.8
	13	53	.757	.100	5	NE.......	1.1		25	66	.903	.000	7	NE.......	1.0
	14	48	.609	.145	0	NE.......	1.2		26	68	.652	.185	5	West......	1.5
	15	58	.609	.185	5	SW.......	2.3		27	68	.595	.215	2	NW.......	1.7
	16	54	.562	.145	3	NW.......	2.7		28	68	.708	.110	8	West......	1.3
	17	49	.645	.155	3	N. NW....	1.1		29	70	.303	.110	6	SE........	0.7
	18	56	.550	.175	0	West......	0.9		30	71	.745	.190	0	SE........	0.6
	19	67	.459	.180	1	SW.......	2.6		31	77	.795	.160	4	West......	1.3
	20	73	.447	......	0	SW.......	2.1	Aug.	1	82	.649	.295	0	W. SW....	2.2
	21	67	.545	.235	0	South.....	1.5		2	79	.702	.195	2	West......	1.8
	22	66	.634	.170	0	SE........	0.7		3	71	.745	.240	0	E. NE.....	0.8
	23	63	.791	.125	9	SW.......	1.9		4	81	.635	.225	4	South.....	0.9
	24	62	.651	.135	6	West......	1.7		5	76	.726	.150	6	W. NW....	1.1
	25	55	.828	.100	8	NE.......	1.2		6	68	.736	.125	1	NE.......	1.8
	26	52	.729	.025	9	NE.......	1.7		7	71	.854	.055	6	West......	0.6
	27	58	.668	.090	7	NE.......	2.5		8	78	.722	.210	7	SW.......	1.9
	28	59	.673	.065	9	NE.......	1.5		9	75	.777	.140	9	West......	1.3
	29	59	.776	.055	8	East.......	0.6		10	77	.744	.210	3	SE........	1.0
	30	62	.925	.000	10	N. NW....	1.1		11	72	.611	.210	3	West......	4.0
	31	53	.911	.000	7	South.....	1.9		12	68	.686	.130	6	SE........	0.6
June	1	55	.619	.160	3	W. NW....	4.2		13	77	.672	.220	2	SW.......	1.2
	2	55	.677	.130	3	North.....	1.7		14	77	.739	.200	1	South.....	1.6
	3	57	.636	.145	6	SE........	0.7		15	71	.806	.130	6	South.....	0.9
	4	61	.616	.180	4	West......	1.6		16	75	.863	.075	7	NE.......	1.5
	5	49	.854	.060	10	NE.......	1.9		17	69	.855	.125	10	East.......	1.2
	6	51	.673	.160	4	NE.......	3.3		18	73	.753	.200	0	South.....	1.2
	7	54	.516	.190	1	NE.......	2.2		19	76	.782	.080	5	East.......	1.5
	8	58	.469	.215	0	NE.......	1.3		20	70	.740	.185	7	NE........	0.9
	9	59	.564	.105	0	East.......	0.5		21	75	.723	.155	5	SW.......	1.3
	10	63	.606	.135	5	SE........	0.2		22	64	.768	.050	7	NE........	1.8
	11	60	.590	.260	0	SE........	0.5		23	63	.838	.050	7	South.....	1.8
	12	60	.676	.210	0	East.......	0.9		24	57	.716	.100	7	NW.......	2.6
	13	68	.637	.200	0	SE........	0.4		25	55	.675	.120	1	N. NW....	0.9
	14	78	.546	.295	1	SW.......	0.9		26	64	.568	.275	1	W. SW....	2.1
	15	72	.564	.305	0	North.....	2.1		27	62	.637	.040	6	South......	1.9
	16	74	.577	.270	0	East.......	0.9		28	54	.672	.150	6	NW.......	3.1
	17	74	.457	.230	4	North.....	1.8		29	49	.571	.080	6	NW.......	2.5
	18	73	.374	.325	1	W. NW....	2.2		30	55	.652	.140	0	South.....	1.0
	19	64	.637	.205	6	West......	1.2		31	58	.672	.170	0	South.....	1.4
	20	58	.682	.110	9	W. NW....	1.6	Sept.	1	62	.721	.140	3	South.....	0.9
	21	61	.656	.095	8	W. NW....	1.2		2	55	.664	.140	3	NE.......	5.4
	22	58	.766	.070	9	NE.......	1.1		3	55	.648	.120	2	NE........	2.2
	23	59	.724	.175	2	S. SE......	0.9		4	62	.775	.195	4	S. SE......	1.6
	24	64	.639	.185	0	SE........	0.9		5	67	.702	.175	2	NW.......	2.1
	25	66	.610	.215	0	SE........	0.5		6	56	.753	.115	4	E. NE.....	1.8
	26	70	.691	.210	2	SE........	0.4		7	62	.888	.035	6	S. SE......	0.9
	27	71	.742	.205	0	SE........	0.8		8	59	.710	.085	7	NE........	3.0
	28	74	.735	.290	4	SE........	0.7		9	54	.673	.130	1	E. NE.....	1.4
	29	70	.865	.000	8	NE.......	1.1		10	61	.922	.000	10	S. SW.....	1.4
	30	67	.859	.075	10	E. SE......	0.5		11	70	.676	.190	8	West......	2.5
July	1	72	.816	.220	6	South.....	1.1		12	57	.768	.090	4	NE........	2.6
	2	74	.757	.165	6	West......	1.5		13	63	.748	.110	0	SW.......	1.4
	3	75	.670	.220	0	W. NW....	1.1		14	71	.648	.240	0	S. SW....	1.8
	4	75	.694	.200	2	SE........	0.5		15	75	.649	.180	0	S. SW.....	1.7
	5	74	.681	.215	1	East.......	0.6		16	75	.676	.170	0	South....	1.7
	6	76	.622	.250	0	NE.......	1.1		17	60	.791	.015	8	West......	3.1

Showing the evaporation and humidity for different winds, &c.—Continued.

Year and day of month.	Mean temperature.	Mean humidity.	Evaporation.	Mean cloudiness.	Duration of wind.	Relative velocity.	Year and day of month.	Mean temperature.	Mean humidity.	Evaporation.	Mean cloudiness.	Direction of wind.	Relative velocity.
1863.							1864.						
Sept. 18	40	.595	.075	6	N. NW	2.7	May 12	49	.673	.150	2	N. NE	2.5
19	44	.658	.090	2	West	1.6	13	48	.548	.190	0	N. NE	2.9
20	58	.555	.170	1	W. SW	2.5	14	54	.604	.255	0	North	3.9
21	53	.696	.110	2	NE	1.7	15	55	.688	.185	2	N. NE	2.2
22	55	.642	.175	0	S. SE	2.2	16	61	.701	.190	1	N. NE	2.4
23	64	.651	.060	9	SW	3.4	17	59	.761	.500	0	N. NE	2.7
24	47	.675	.185	10	N. NE	3.8	18	62	.628	.500	0	N. NE	1.4
25	48	.650	.125	1	E. NE	2.1	19	62	.634	.230	4	Calm	0.0
26	52	.697	.165	3	South	1.7	20	76	.425	.300	0	West	1.0
27	67	.590	.230	1	SW	1.8	21	80	.374	.455	2	W. SW	2.0
28	67	.650	.210	3	S. SW	0.7	22	55	.727	.185	0	NE	0.5
29	62	.709	.170	0	SE	0.5	23	71	.519	.360	0	W. SW	2.0
30	63	.709	.120	2	S. SE	1.0	24	59	.611	.140	6	South	0.4
Oct. 1	52	.775	.045	4	South	2.0	25	51	.767	.040	10	N. NE	3.4
2	50	.790	.030	7	West	1.5	26	56	.612	.085	3	N. NE	1.5
3	49	.856	.005	10	S. SW	2.5	27	54	.414	.285	0	NE	2.3
4	43	.857	.000	10	W. NW	3.5	28	56	.598	.435	3	E. SE	1.6
5	40	.769	.030	7	W. NW	2.2	29	66	.442	.710	6	SW	2.2
6	45	.756	.045	10	South	0.7	30	75	.503	.710	0	SW	2.6
7	44	.806	.040	5	NE	1.5	31	52	.601	.175	3	North	4.2
8	49	.753	.020	5	West	1.6	June 1	55	.555	.285	7	N. NE	0.3
9	46	.692	.105	3	N. NE	3.9	2	55	.567	.200	2	NE	0.4
10	39	.714	.115	2	North	1.4	3	66	.591	.325	4	SW	0.1
11	44	.754	.020	0	South	1.5	4	68	.386	.275	5	South	0.7
12	51	.635	.110	0	East	3.0	5	75	.435	.393	4	West	1.5
13	52	.733	.025	4	East	1.5	6	51	.419	.262	0	North	2.3
14	51	.824	.045	1	N. NW	0.5	7	55	.705	.128	5	E. SE	0.5
15	51	.845	.090	0	SE	0.7	8	67	.667	.167	4	S. SW	0.8
16	54	.868	.060	10	E. NE	0.1	9	59	.629	.240	4	North	2.8
17	56	.852	.030	4	South	2.0	10	48	.633	.190	0	North	3.2
18	42	.745	.130	7	SW	4.7	11	51	.529	.225	0	N. NE	2.4
19	46	.605	.080	7	South	2.6	12	52	.495	.215	0	N. NE	2.4
1864.							13	52	.660	.175	0	NE	0.5
April 2	39	.880	.105	8	NW	0.3	14	57	.569	.205	0	E. SE	0.4
3	39	.866	......	10	N. NE	0.9	15	63	.508	.200	0	E. SE	0.5
4	37	.902	.015	10	North	3.5	16	68	.475	.290	0	E. SE	0.3
5	39	.862	.040	10	North	1.2	17	67	.596	.200	3	Calm	0.0
6	35	.967	.020	10	N. NE	1.8	18	66	.699	.240	5	E. SE	0.4
7	41	.942	......	6	East	0.5	19	72	.743	.190	6	East	0.5
8	41	.913	.020	9	N. NE	2.7	20	71	.765	.255	2	E. NE	0.6
9	38	.937	.030	10	North	2.9	21	73	.683	.370	4	East	0.4
10	40	.799	.030	7	NW	0.8	22	78	.727	.080	1	E. SE	0.6
11	39	.877	.010	7	North	0.1	23	81	.656	.350	2	South	0.5
12	42	.776	.040	10	W. NW	1.2	24	89	.574	.510	3	S. SW	1.1
13	43	.629	.070	6	W. NW	1.1	25	84	.573	.495	2	W. SW	2.6
14	38	.765	.065	4	N. NE	1.4	26	76	.752	.495	3	West	3.7
15	36	.760	.115	8	N. NE	2.0	27	52	.781	.165	3	N. NE	3.1
16	35	.749	.115	10	North	0.5	28	59	.705	.050	9	South	0.4
17	40	.803	.115	4	South	0.3	29	81	.616	.280	8	SW	0.9
18	39	.681	.300	2	N. NE	0.5	30	66	.753	.075	3	West	1.1
19	40	.480	.300	0	N. NE	0.9	July 1	56	.895	.005	10	N. NE	0.8
20	42	.561	.130	0	E. SE	0.3	2	66	.695	.205	5	W. NW	0.8
21	46	.642	.165	3	E. SE	0.7	3	70	.488	.275	2	Calm	0.0
22	47	.855	.165	5	Calm	0.0	4	72	.477	.160	1	S. SW	0.4
23	39	.757	.120	7	North	3.5	5	71	.604	.150	7	South	0.6
24	37	.857	......	10	N. NE	3.5	6	67	.740	.055	8	N. NE	0.8
25	44	.933	......	10	N. NW	1.0	7	74	.680	.355	5	W. NW	1.0
26	54	.676	.170	3	E. SE	2.1	8	72	.677	.355	0	East	0.3
27	38	.597	.175	3	N. NE	5.3	9	73	.700	.095	5	E. SE	0.9
28	39	.641	.140	3	N. NE	4.2	10	77	.638	.435	5	West	1.8
29	40	.645	.125	10	East	1.6	11	73	.498	.435	0	W. NW	1.8
30	41	.914	.070	7	NE	1.0	12	66	.654	.435	0	NE	1.0
May 1	44	.668	.245	4	West	1.0	13	67	.784	.145	2	East	0.6
2	38	.748	.235	3	Calm	0.0	14	70	.649	.210	0	E SE	0.9
3	42	.609	.235	0	NW	0.7	15	73	.623	.220	0	SE	0.7
4	53	.600	.190	0	SE	1.2	16	75	.559	.075	6	E.SE	0.9
5	69	.584	.335	4	S. SW	2.7	17	75	.732	.130	9	South	1.6
6	40	.850	......	10	N. NE	2.9	18	70	.849	.210	8	South	1.2
7	42	.985	......	10	N. NE	0.9	19	71	.775	.210	5	South	1.4
8	45	.887	.045	10	N. NE	0.6	20	69	.560	.205	0	N. NE	2.4
9	62	.777	.195	5	SW	2.6	21	61	.553	.155	0	N. NE	2.6
10	35	.649	.300	0	N. NE	6.3	22	68	.510	.400	1	South	0.6
11	44	.680	.300	3	SE	1.0	23	71	.515	.400	1	West	1.2

Showing the evaporation and humidity for different winds, &c.—Continued.

Year and day of month.	Mean temperature.	Mean humidity.	Evaporation.	Mean cloudiness.	Duration of wind.	Relative velocity.	Year and day of month.	Mean temperature.	Mean humidity.	Evaporation.	Mean cloudiness.	Direction of wind.	Relative velocity.
1864.							1864.						
July 24	72	.575	.355	0	W.SW....	1.0	Aug. 28	65	.550	.180	7	NW.......	1.3
25	75	.599	.355	3	West.......	0.7	29	61	.622	.080	8	N. NE.....	0.7
26	66	.737	.310	2	N. NE.....	0.8	30	61	.536	.120	2	E. NE.....	0.5
27	73	.717	.310	5	SE.........	0.5	31	62	.560	.135	0	E. SE.....	0.6
28	81	.575	.280	2	SW.......	1.2	Sept. 1	68	.590	.125	1	SE.........	1.0
29	77	.705	.190	4	W. SW....	0.8	2	68	.686	.050	8	NE.........	1.1
30	83	.505	.250	2	SW.......	0.7	3	66	.755	.070	9	NE.........	2.1
31	75	.710	.080	10	South.....	1.1	4	63	.723	.030	9	NE.........	3.7
Aug. 1	70	.742	.100	5	W. NW....	1.0	5	62	.667	.060	10	NE.........	2.9
2	67	.759	.155	5	N. NE.....	1.6	6	64	.693	.070	7	East.......	2.2
3	69	.701	.135	4	NE.........	0.7	7	63	.747	.000	7	SE.........	0.8
4	68	.697	.090	7	N. NE.....	1.3	8	67	.791	.005	2	West.......	1.1
5	70	.772	.105	5	N. NE.....	2.1	9	74	.566	.095	6	SW.......	2.1
6	71	.677	.180	3	N. NE.....	0.8	10	65	.750	.025	2	N. NE.....	0.6
7	75	.564	.175	0	Calm.......	0.0	11	61	.659	.115	0	N. NE.....	2.4
8	74	.678	.200	0	SE.........	0.5	12	62	.753	.070	8	E. SE.....	2.1
9	81	.628	.370	3	South.....	0.7	13	61	.773	.030	9	SE.........	2.0
10	80	.661	.320	2	S. SW.....	0.9	14	64	.649	.100	2	West.......	2.9
11	81	.695	.180	3	E. SE.....	0.8	15	60	.548	.095	0	West.......	2.0
12	80	.661	.120	5	S. SW.....	1.5	16	61	.652	.155	2	NW.......	0.7
13	77	.615	.150	3	West.......	1.2	17	66	.598	.020	5	South.....	2.0
14	75	.575	.145	2	NE.........	0.7	18	51	.579	.185	5	W. NW....	1.6
15	73	.722	.145	7	E. SE.....	0.5	19	51	.652	.045	0	SW.......	0.6
16	69	.605	.100	10	N. NE.....	3 1	20	57	.646	.090	0	SE.........	0.3
17	61	.512	.145	1	North.....	2.3	21	61	.768	.000	6	N. NE.....	1.1
18	65	.694	.155	0	East.......	0.4	22	72	.602	.145	7	South.....	1.9
19	65	.514	.135	0	East.......	0.3	23	59	.724	.015	7	West.......	1.2
20	65	.620	.125	8	N. NE.....	0.9	24	47	.570	.000	0	West.......	2.3
21	65	.679	.090	6	NE.........	0.6	25	57	.465	.120	5	S. SE......	0.5
22	67	.701	.110	6	SE.........	0.7	26	68	.502	.140	1	S SW.....	2.8
23	67	.774	.040	7	S. SE......	2.0	27	58	.685	.035	6	West.......	1.8
24	74	.705	.190	4	S. SW.....	1.3	28	49	.515	.000	6	East.......	1.1
25	72	.388	.230	0	West.......	3.8	29	50	.677	.015	10	N. NE.....	1.7
26	69	.419	.210	3	West.......	2.4	30	49	.711	.090	5	East.......	0.7
27	69	.424	.160	5	W. NW....	2.4							

TABLE Y.—*Milwaukee for* 1862.

Direction of wind.	Mean temperature.	Mean humidity.	Mean evaporation.	Mean cloudiness.	Number of days.	Mean relative velocity.	Direction of wind.	Mean temperature.	Mean humidity.	Mean evaporation.	Mean cloudiness.	Number of days.	Mean relative velocity.
North	46	.729	.050	5	2	1.7	S.SW	66	.644	.205	3	7	2.0
N.NE	54	.669	.151	4	36	2.1	SW	61	.680	.161	3	25	1.6
NE	55	.769	.144	6	12	1.5	W.SW	58	.691	.068	3	3	1.0
E.NE	...	......	......	....	0	......	West	67	.758	.164	3	13	1.2
East	61	.700	.180	4	13	0.5	W.NW	65	.633	.164	4	13	1.8
E.SE	58	.666	.188	3	12	0.5	NW	56	.672	.154	3	6	1.5
SE	65	.760	.139	4	13	0.6	N.NW	58	.632	.163	2	8	1.1
S.SE	62	.751	.141	3	7	0.9	Calm	66	.732	.144	4	8	0.0
South	63	.713	.205	5	7	0.7							

Mean relative velocity.	Mean temperature.	Mean humidity.	Mean evaporation.	Mean cloudiness.	Number of days.	Mean relative velocity.	Mean temperature.	Mean humidity.	Mean evaporation.	Mean cloudiness.	Number of days.
0.0—0.4	58	.717	.143	4	36	2.1—2.6	58	.716	.151	6	22
0.5—0.9	63	.717	.166	3	51	2.7—3.5	58	.652	.160	4	14
1.0—1.4	62	.681	.168	3	31	3.6—4.5	61	.503	.236	1	2
1.5—2.0	58	.657	.154	3	26	4.6—5.6	51	.535	.159	5	3

Mean cloudiness.	Mean temperature.	Mean humidity.	Mean evaporation.	Number of days.	Mean relative velocity.	Mean cloudiness.	Mean temperature.	Mean humidity.	Mean evaporation.	Number of days.	Mean relative velocity.
0.	60	.649	.186	47	1.1	6.	65	.706	.110	10	1.3
1.	66	.685	.206	13	1.2	7.	61	.725	.145	15	1.2
2.	65	.617	.172	14	1.4	8.	58	.767	.133	10	1.3
3.	60	.641	.171	18	1.5	9.	52	.769	.049	4	1.3
4.	66	.685	.186	19	1.2	10.	56	.827	.074	18	1.4
5.	63	.684	.169	19	1.7						

Mean temperature.	Mean humidity.	Mean evaporation.	Mean cloudiness.	Number of days.	Mean relative velocity.	Mean temperature.	Mean humidity.	Mean evaporation.	Mean cloudiness.	Number of days.	Mean relative velocity.
30	.681	....	4	2	1.6	60	.706	.123	4	25	1.1
35	.634	.080	5	5	1.9	65	.724	.148	5	36	0.9
40	.663	.065	5	8	1.2	70	.677	.171	4	30	1.2
45	.705	.104	5	18	1.3	75	.675	.242	3	14	1.1
50	.649	.151	4	18	2.0	80	.588	.335	0	2	1.0
55	.679	.158	3	23	1.6	85	.609	.108	3	1	0.5

Milwaukee for 1862—Continued.

Mean evaporation.	Mean temperature.	Mean humidity.	Mean cloudiness.	Number of days.	Mean relative velocity.	Mean evaporation.	Mean temperature.	Mean humidity.	Mean cloudiness.	Number of days.	Mean relative velocity.
.000	47	.753	9	6	1.0	.210	64	.675	3	27	1.6
.030	58	.759	7	12	1.1	.240	71	.655	3	12	1.0
.060	52	.714	4	15	1.4	.270	70	.586	3	7	1.5
.090	56	.707	5	15	1.4	.300	75	.668	2	2	1.3
.120	57	.684	4	21	1.6	.330	80	.659	0	2	1.8
.150	62	.703	4	26	1.4	.360	....	....	....	....	....
.180	63	.656	1	22	0.9	.390	75	.615	2	2	0.9

Mean humidity.	Mean temperature.	Mean evaporation.	Mean cloudiness.	Number of days.	Mean relative velocity.	Mean humidity.	Mean temperature.	Mean evaporation.	Mean cloudiness.	Number of days.	Mean relative velocity.
.400	59	.175	2	5	2.2	.700	60	.151	4	35	1.3
.450	62	.234	2	10	0.9	.750	61	.140	5	29	1.1
.500	54	.155	2	11	2.6	.800	67	.128	5	19	1.2
.550	60	.196	3	14	1.7	.850	60	.093	8	10	0.8
.600	63	.189	3	23	1.4	.900	60	.114	10	4	0.8
.650	63	.178	2	27	1.0						

Milwaukee for 1863.

Day of month.	Mean temperature.	Mean humidity.	Mean evaporation.	Mean cloudiness.	Relative velocity.	Direction of wind.	Day of month.	Mean temperature.	Mean humidity.	Mean evaporation.	Mean cloudiness.	Relative velocity.	Direction of wind.
Oct. 20	43	.621	.075	6	2.5	W.SW ..	Oct. 26	37	.727	.055	6	0.4	NE.
21	39	.578	.055	2	1.8	W.NW ..	27	37	.714	.005	3	0.6	East.
22	36	.955	.000	9	0.7	NW	28	44	.719	.070	7	1.8	S.SE.
23	33	.728	.035	10	2.6	W.NW ..	29	46	.921	.000	10	1.8	South.
24	35	.644	.050	9	2.3	North ...	30	36	.787	.000	10	2.3	N.NW.
25	35	.688	.015	4	1.1	N.NE ...	-31	32	.731	....	6	0.9	NW.

Mean cloudiness.	Mean temperature.	Mean humidity.	Mean evaporation.	Number of days.	Relative velocity.	Mean cloudiness.	Mean temperature.	Mean humidity.	Mean evaporation.	Number of days.	Relative velocity.
0.	61	.630	.188	48	1.5	6.	57	.714	.114	21	1.4
1.	62	.611	.180	17	1.5	7.	56	.744	.088	19	2.1
2.	56	.609	.158	17	1.4	8.	65	.754	.091	8	1.4
3.	54	.643	.153	19	2.5	9.	56	.763	.063	12	1.6
4.	58	.717	.133	17	1.9	10.	51	.813	.050	25	2.2
5.	63	.691	.141	10	1.4						

Milwaukee for 1863—Continued.

Direction of wind.	Mean temperature.	Mean humidity.	Mean evaporation.	Mean cloudiness.	Number of days.	Relative velocity.	Direction of wind.	Mean temperature.	Mean humidity.	Mean evaporation.	Mean cloudiness.	Number of days.	Relative velocity.
North	58	.646	.145	4	6	1.6	South	60	.720	.120	4	21	1.5
N.NE	45	.626	.143	4	11	3.5	S.SW	62	.750	.111	5	6	1.5
NE	54	.715	.100	6	45	2.2	SW	66	.659	.160	4	13	2.1
E.NE	59	.680	.159	2	8	1.0	W.SW	62	.598	.204	2	4	2.3
East	59	.677	.128	2	15	0.9	West	64	.696	.139	5	19	1.8
S.SE	55	.716	.142	3	3	0.8	W.NW	59	.648	.148	5	13	1.9
SE	62	.703	.168	3	26	0.8	NW	53	.683	.130	5	9	1.9
S.SE	55	.733	.129	4	7	1.4	N.NW	49	.742	.066	5	6	1.4

Relative velocity.	Mean temperature.	Mean humidity.	Mean evaporation.	Mean cloudiness.	Number of days.	Relative velocity.	Mean temperature.	Mean humidity.	Mean evaporation.	Mean cloudiness.	Number of days.
0.0—0.4	56	.574	.128	4	12	2.1—2.6	55	.635	.136	5	33
0.5—0.9	62	.711	.147	3	47	2.7—3.5	47	.704	.096	6	15
1.0—1.4	62	.715	.133	5	43	3.6—4.5	55	.633	.178	3	8
1.5—2.0	51	.725	.112	4	46	4.6—5.6	50	.641	.123	6	8

Mean temperature.	Mean humidity.	Mean evaporation.	Mean cloudiness.	Number of days.	Relative velocity.	Mean temperature.	Mean humidity.	Mean evaporation.	Mean cloudiness.	Number of days.	Relative velocity.
30	.709	.118	5	4	2.5	60	.693	.142	4	32	1.6
35	.702	.048	4	14	2.8	65	.678	.153	4	20	1.2
40	.741	.049	6	15	2.3	70	.686	.146	3	24	1.4
45	.695	.119	5	25	2.0	75	.706	.188	3	20	1.2
50	.686	.108	4	24	1.8	80	.642	.255	2	2	1.5
55	.679	.123	4	32	2.0						

Mean evaporation.	Mean temperature.	Mean humidity.	Mean cloudiness.	Number of days.	Relative velocity.	Mean evaporation.	Mean temperature.	Mean humidity.	Mean cloudiness.	Number of days.	Relative velocity.
.000	51	.851	8	24	1.8	.180	64	.668	3	24	1.7
.030	51	.774	7	20	1.5	.210	66	.631	2	3	1.5
.060	54	.716	7	17	1.8	.240	68	.659	0	6	1.5
.090	52	.693	5	27	2.1	.270	72	.582	2	8	1.5
.120	58	.672	4	27	1.8	.300	69	.538	1	3	1.4
.150	62	.664	3	25	1.7						

Milwaukee for 1863—Continued.

Mean humidity.	Mean temperature.	Mean evaporation.	Mean cloudiness.	Number of days.	Relative velocity.	Mean humidity.	Mean temperature.	Mean evaporation.	Mean cloudiness.	Number of days.	Relative velocity.
.350	62	.275	1	3	1.2	.650	58	.143	4	40	1.8
.400	60	.215	1	2	3.1	.700	61	.136	3	34	1.4
.450	59	.207	3	7	2.6	.750	56	.090	6	26	1.7
.500	52	.168	2	9	1.9	.800	58	.082	6	13	1.6
.550	61	1.192	2	18	1.9	.850	57	.041	8	15	1.5
.600	58	.166	3	35	1.7	.900	51	.021	9	10	1.5

Milwaukee for 1864.

Direction of wind.	Mean temperature.	Mean humidity.	Mean evaporation.	Mean cloudiness.	Number of days.	Relative velocity.	Direction of wind.	Mean temperature.	Mean humidity.	Mean evaporation.	Mean cloudiness.	Number of days.	Relative velocity.
North	46	.707	.135	5	12	2.5	S.SW	75	.604	.243	3	8	1.4
N.NE	53	.705	.116	5	42	2.0	SW	71	.581	.210	4	9	1.4
NE	65	.673	.125	4	13	1.4	W.SW	77	.507	.335	2	5	2.7
E.NE	66	.600	.187	2	2	0.5	West	67	.598	.163	3	17	1.8
East	60	.691	.142	4	11	0.8	W.NW	61	.628	.127	5	8	1.4
E.SE	64	.635	.177	3	17	0.8	NW	49	.698	.118	5	5	0.8
SE	63	.675	.121	3	10	0.9	N.NW	44	.933	......	10	1	1.0
S.SE	62	.605	.080	6	2	1.2	Calm	60	.648	.220	3	6	0.0
South	68	.653	.171	6	14	0.9							

Mean cloudiness.	Mean temperature.	Mean humidity.	Mean evaporation.	Number of days.	Relative velocity.	Mean cloudiness.	Mean temperature.	Mean humidity.	Mean evaporation.	Number of days.	Relative velocity.
0	61	.570	.189	41	1.6	6	61	.653	.080	12	1.1
1	68	.604	.180	8	2.0	7	58	.715	.096	14	1.3
2	68	.611	.201	20	1.1	8	61	.725	.110	9	1.1
3	62	.615	.213	20	2.1	9	61	.767	.055	6	2.1
4	62	.659	.240	13	1.1	10	46	.870	.032	19	1.9
5	65	.671	.169	20	1.2						

Relative velocity.	Mean temperature.	Mean humidity.	Mean evaporation.	Mean cloudiness.	Number of days.	Relative velocity.	Mean temperature.	Mean humidity.	Mean evaporation.	Mean cloudiness.	Number of days.
0.0—0.4	59	.643	.190	3	25	2.1—2.6	62	.588	.155	3	24
0 5—0.9	68	.677	.152	4	55	2.7—3.5	52	.717	.125	6	17
1.0—1.4	62	.691	.126	5	31	3.6—4.5	59	.618	.166	3	6
1.5—2.0	63	.634	.170	5	22	4.6—5.6	36	.623	.175	2	2

Milwaukee for 1864—Continued.

Mean temperature.	Mean humidity.	Mean evaporation.	Mean cloudiness.	Number of days.	Relative velocity.	Mean temperature.	Mean humidity.	Mean evaporation.	Mean cloudiness.	Number of days.	Relative velocity.
35	.795	.076	7	17	2.3	65	.625	.140	4	36	1.3
40	.762	.086	6	16	1.2	70	.641	.198	3	26	1.1
45	.670	.094	4	9	1.6	75	.609	.187	4	14	1.3
50	.603	.172	3	14	2.2	80	.594	.289	3	10	1.2
55	.642	.150	5	17	1.1	85	.574	.510	3	1	1.1
60	.651	.109	4	21	1.7						

Mean humidity.	Mean temperature.	Mean evaporation.	Mean cloudiness.	Number of days.	Relative velocity.	Mean humidity.	Mean temperature.	Mean evaporation.	Mean cloudiness.	Number of days.	Relative velocity.
.350	73	.320	2	3	2.2	.700	64	.109	6	24	0.9
.400	66	.268	3	7	2.0	.750	55	.087	5	23	1.9
.450	62	.210	1	7	0.9	.800	55	....	6	2	0.7
.500	64	.169	1	14	2.0	.850	42	.041	9	9	1.2
.550	65	.186	3	26	1.4	.900	40	.034	9	6	1.9
.600	59	.167	4	27	1.8	.950	38	.010	10	2	1.3
.650	64	.146	4	32	1.1						

Mean evaporation.	Mean temperature.	Mean humidity.	Mean cloudiness.	Number of days.	Relative velocity.	Mean evaporation.	Mean temperature.	Mean humidity.	Mean cloudiness.	Number of days.	Relative velocity.
.000	60	.752	7	14	1.5	.240	61	.611	2	7	1.7
.030	52	.716	8	14	1.6	.270	68	.501	3	7	0.8
.060	60	.705	6	13	1.5	.300	74	.559	2	3	0.7
.090	61	.687	5	15	1.4	.330	75	.620	3	2	1.6
.120	61	.619	4	21	1.3	.360	75	.610	2	3	1.0
.150	62	.625	3	16	1.7	.390	75	.435	4	1	1.5
.180	63	.633	2	21	1.3	.420	75	.546	3	4	1.6
.210	64	.534	1	7	1.8						

TABLE Z.—*Milwaukee for* 1862, 1863, *and* 1864.

Direction of wind.	Mean temperature.	Mean humidity.	Mean evaporation.	Mean cloudiness.	Number of days.	Mean relative velocity.	Direction of wind.	Mean temperature.	Mean humidity.	Mean evaporation.	Mean cloudiness.	Number of days.	Mean relative velocity.
North	52	.688	.141	5	19	2.3	S. SW	68	.659	.192	4	21	1.8
N. NE	53	.681	.137	5	89	2.2	SW	65	.696	.169	3	47	1.8
NE	56	.717	.112	5	70	1.9	W. SW	67	.584	.202	3	12	1.7
E. NE	60	.664	.165	2	10	0.9	West	68	.697	.150	4	49	1.7
East	60	.689	.149	4	39	0.8	W. NW	62	.645	.153	5	34	1.8
E. SE	61	.654	.172	3	32	0.7	NW	53	.683	.135	4	20	1.5
SE	63	.713	.150	3	49	0.7	N. NW	53	.696	.121	4	15	1.2
S. SE	59	.725	.127	4	16	1.2	Calm	64	.689	.203	3	14	0.0
South	63	.699	.150	5	42	1.2							

Milwaukee for 1862, 1863, *and* 1864—Continued.

Mean cloudiness.	Mean temperature.	Mean humidity.	Mean evaporation.	Number of days.	Mean relative velocity.	Mean cloudiness.	Mean temperature.	Mean humidity.	Mean evaporation.	Number of days.	Mean relative velocity.
0.	60	.619	.187	136	1.3	6.	60	.695	.104	43	1.3
1.	66	.640	.183	38	1.4	7.	58	.750	.105	48	1.5
2.	63	.621	.179	51	1.3	8.	61	.770	.113	27	1.3
3.	58	.643	.177	57	1.9	9.	61	.764	.059	22	1.7
4.	63	.689	.181	49	1.4	10.	50	.822	.056	63	1.8
5.	65	.681	.162	49	1.6						

Mean relative velocity.	Mean temperature.	Mean humidity.	Mean evaporation.	Mean cloudiness.	Number of days.	Mean relative velocity.	Mean temperature.	Mean humidity.	Mean evaporation.	Mean cloudiness.	Number of days.
0.0	58	.668	.164	4	73	2.1	58	.644	.147	4	79
0.5	62	.628	.156	4	153	2.7	52	.697	.124	5	46
1.0	62	.697	.142	4	105	3.6	57	.611	.114	3	16
1.5	60	.686	.136	4	94	4.6	48	.607	.138	5	13

Mean temperature.	Mean humidity.	Mean evaporation.	Mean cloudiness.	Number of days.	Mean relative velocity.	Mean temperature.	Mean humidity.	Mean evaporation.	Mean cloudiness.	Number of days.	Mean relative velocity.
30	.700	.118	5	6	2.2	60	.689	.131	4	78	1.6
35	.737	.076	6	36	2.1	65	.676	.150	4	92	1.1
40	.753	.065	6	38	1.7	70	.668	.172	3	80	1.2
45	.694	.105	5	52	1.7	75	.668	.204	3	48	1.2
50	.654	.138	4	56	2.0	80	.615	.287	2	14	1.2
55	.671	.141	4	77	1.9	85	.591	.309	3	2	0.8

Mean humidity.	Mean temperature.	Mean evaporation.	Mean cloudiness.	Number of days.	Mean relative velocity.	Mean humidity.	Mean temperature.	Mean evaporation.	Mean cloudiness.	Number of days.	Mean relative velocity.
.350	68	.298	1	6	1.5	.700	61	.136	4	93	1.2
.400	62	.225	2	14	2.2	.750	59	.104	5	78	1.4
.450	61	.217	2	24	1.4	.800	63	.102	5	34	1.3
.500	58	.164	2	34	2.0	.850	54	.055	9	34	1.2
.550	62	.187	3	58	1.5	.900	50	.040	9	20	1.5
.600	60	.179	3	85	1.6	.950	38	.010	10	2	1.3
.650	61	.159	3	99	1.4						

Milwaukee for 1862, 1863, *and* 1864—Continued.

Mean evaporation.	Mean temperature.	Mean humidity.	Mean cloudiness.	Number of days.	Mean relative velocity.	Mean evaporation.	Mean temperature.	Mean humidity.	Mean cloudiness.	Number of days.	Mean relative velocity.
.000	53	.808	8	44	1.6	.240	68	.640	2	25	1.3
.030	54	.753	7	46	1.4	.270	70	.557	3	22	0.8
.060	55	.712	6	45	1.4	.360	72	.578	2	8	0.8
.090	54	.696	5	57	1.7	.330	77	.640	1	4	1.7
.120	59	.660	4	69	1.6	.360	75	.610	2	3	1.0
.150	62	.670	3	67	1.6	.390	75	.555	3	3	1.1
.180	63	.655	2	67	1.3	.420	75	.546	3	4	1.6
.210	65	.640	2	58	1.6						

TABLE AA.—*Showing the wind, water, barometer, and thermometer at Milwaukee, Wisconsin, from April* 1, 1861, *to December* 31, 1864.

Date.	Hour of day.	WIND.		Height of water below zero of 1838.	Barometer reduced 32°.	Therm'r detached.
		Course.	Relative velocity.			
1861. April 1	3 a. m.	NE	4.1			
	7 a. m.				29.193	33
	9 a. m.	North	3.8			
	2 p. m.				29.396	39
	3 p. m.	W.NW	1.9			
	9 p. m.	SW	0.2		29.496	39
2	3 a. m.	West	0.4			
	7 a. m.				29.560	36
	9 a. m.	NW	0.5			
	2 p. m.				29.516	51
	3 p. m.					
	9 p. m.	SW	0.7		29.501	45
3	3 a. m.	North	0.7			
	7 a. m.				29.555	38
	9 a. m.	NE	1.9			
	2 p. m.				29.599	43
	3 p. m.	NE	3.3			
	9 p. m.	N. NE	2.7		29.596	36
4	3 a. m.	E.SE	3.7			
	7 a. m.				29.605	39
	9 a. m.	East	4.1			
	2 p. m.				29.509	41
	3 p. m.	E. NE	3.4			
	9 p. m.	East	3.2		29.521	40
5	3 a. m.	East	3.1			
	7 a. m.				29.475	39
	9 a. m.	E. NE	3.1			
	2 p. m.				29.399	40
	3 p. m.	E. NE	2.3			
	9 p. m.	E. NE	1.3		29.431	39
6	3 a. m.	E. NE	0.3			
	7 a. m.				29.312	39
	9 a. m.	E. SE	2.9	3.01		
	2 p. m.				29.176	42
	3 p. m.	SE	4.9	3.01		
	9 p. m.	SE	5.2	2.95	29.105	42
7	3 a. m.	S. SE	2.4	2.99		
	7 a. m.				29.141	43
	9 a. m.	SE	0.6	3.01		
	2 p. m.				29.158	44
	3 p. m.	E. NE	1.6	2.95		
	9 p. m.	East	3.3	2.86	29.113	42
8	3 a. m.	E. SE	3.2	2.88		
	7 a. m.				29.048	44
	9 a. m.	E. SE	2.4	2.98		
	2 p. m.				29.080	40
	3 p. m.	East	1.1	3.01		
	9 p. m.	N. NE	4.2	2.91	29.083	39
9	3 a. m.	NE	3.5	2.95		
	7 a. m.				29.136	41
	9 a. m.	N. NE	3.4	2.99		
	2 p. m.				29.207	39
	3 p. m.	N. NE	3.6	3.00		
	9 p. m.	N. NE	3.5	3.06	29.331	41
10	3 a. m.	NE	3.4	3.04		
	7 a. m.				29.422	46
	9 a. m.	E. NE	2.9	3.14		
	2 p. m.				29.417	40
	3 p. m.	N. NE	3.2	3.12		
	9 p. m.	N. NE	2.0	3.13	29.382	42
11	3 a. m.	NE	1.5	3.11		
	7 a. m.				29.322	45
	9 a. m.	East	1.3	3.13		
	2 p. m.				29.214	45
	3 p. m.	North	3.6	3.08		
	9 p. m.	North	1.1	3.11	29.133	41
12	3 a. m.	West	0.1	3.11		
	7 a. m.				29.078	44
	9 a. m.	South	0.1	3.12		
	2 p. m.				29.024	47
	3 p. m.			3.11		
	9 p. m.	N. NE	0.4	3.20	28.995	42
1861. April 13	3 a. m.	Calm	0.0	3.15		
	7 a. m.				29.111	45
	9 a. m.	NW	1.5	3.22		
	2 p. m.				29.088	51
	3 p. m.	East	1.8	3.21		
	9 p. m.	E NE	1.4	3.22	29.231	43
14	3 a. m.	NW	0.8	3.25		
	7 a. m.				29.392	38
	9 a. m.	East	1.9	3.30		
	2 p. m.				29.474	41
	3 p. m.	SE	3.2	3.25		
	9 p. m.	South	1.4	3.21	29.421	38
15	3 a. m.	NE	2.6	3.16		
	7 a. m.				29.380	33
	9 a. m.	N. NE	4.7	3.06		
	2 p. m.				29.404	36
	3 p. m.	NE	4.0	3.11		
	9 p. m.	NE	3.9	3.00	29.434	32
16	3 a. m.	NE	4.0	2.95		
	7 a. m.				29.435	35
	9 a. m.	N. NE	5.2	2.97		
	2 p. m.				29.406	36
	3 p. m.	N. NE	4.9	2.98		
	9 p. m.	N. NW	1.2	3.12	29.409	31
17	3 a. m.	NW	1.2	3.14		
	7 a. m.				29.397	33
	9 a. m.	E. SE	1.4	2.21		
	2 p. m.				29.199	38
	3 p. m.	S. SE	2.2	3.25		
	9 p. m.	S. SE	4.0	3.26	29.021	36
18	3 a. m.	West	2.1	3.20		
	7 a. m.				28.831	41
	9 a. m.	W. NW	4.5	3.17		
	2 p. m.				29.031	40
	3 p. m.	North	4.3	2.92		
	9 p. m.	North	2.6	3.11	29.346	36
19	3 a. m.	N. NW	2.5	3.06		
	7 a. m.				29.483	35
	9 a. m.	E. NE	1.9	3.15		
	2 p. m.				29.472	43
	3 p. m.	SE	2.8	3.23		
	9 p. m.	S. SW	1.6	3.31	29.419	36
20	3 a. m.	S. SW	3.0	3.35		
	7 a. m.				29.302	42
	9 a. m.	SW	5.1	3.35		
	2 p. m.				29.194	58
	3 p. m.	SW	3.8	3.25		
	9 p. m.	South	0.7	3.16	29.211	48
21	3 a. m.	Calm	0.0	3.12		
	7 a. m.				29.158	44
	9 a. m.	SE	1.7	2.99		
	2 p. m.				28.988	55
	3 p. m.	South	3.4	3.04		
	9 p. m.	South	1.5	2.95	28.930	57
22	3 a. m.	SW	3.5	3.02		
	7 a. m.				28.918	63
	9 a. m.	SW	4.5	3.01		
	2 p. m.				29.025	73
	3 p. m.	W. NW	2.5	3.06		
	9 p. m.	North	0.3	2.96	29.130	58
23	3 a. m.	N. NE	3.8	3.00		
	7 a. m.				29.216	43
	9 a. m.	North	2.9	2.97		
	2 p. m.				29.053	54
	3 p. m.	NE	1.1	3.01		
	9 p. m.	W. SW	3.3	3.06	29.088	53
24	3 a. m.	W. SW	4.1	3.07		
	7 a. m.				29.138	47
	9 a. m.	W. SW	5.9	3.25		
	2 p. m.				29.153	45
	3 p. m.	West	5.1	3.25		
	9 p. m.	W. NW	1.3	3.23	29.248	58

Table AA.—*Showing the wind, water, barometer, &c.*—Continued.

Date.	Hour of day.	Wind. Course.	Wind. Relative velocity.	Height of water below zero of 1838.	Barometer reduced to 32°.	Therm'r detached.
1861. April 25	3 a. m.	Calm	0.0	3.25		
	7 a. m.				29.335	42
	9 a. m.	E. SE	0.7	3.28		
	2 p. m.				29.296	48
	3 p. m.	SE	3.5	3.11		
	9 p. m.	S. SE	2.4	2.98	29.264	45
26	3 a. m.	S. SE	1.5	2.87		
	7 a. m.				29.148	46
	9 a. m.	E. NE	0.5	2.86		
	2 p. m.				29.011	63
	3 p. m.	South	3.9	2.73		
	9 p. m.	South	3.1	2.69	28.930	67
27	3 a. m.	W. SW	2.0	2.69		
	7 a. m.				28.918	51
	9 a. m.	NW	2.9	2.74		
	2 p. m.				28.960	58
	3 p. m.	NW	1.5	2.86		
	9 p. m.	W.NW	0.3	2.93	28.979	50
28	3 a. m.	W.NW	0.9	3.04		
	7 a. m.				29.103	50
	9 a. m.	S. SW	2.1	3.07		
	2 p. m.				29.055	67
	3 p. m.	SW	3.2	3.00		
	9 p. m.	South	2.5	3.00	28.973	60
29	3 a. m.	West	0.7	2.97		
	7 a. m.				29.177	63
	9 a. m.	West	1.6	2.95		
	2 p. m.				29.176	54
	3 p. m.	West	3.0	2.94		
	9 p. m.	West	0.2	2.98	29.219	47
30	3 a. m.	Calm	0.0	2.96		
	7 a. m.				29.319	49
	9 a. m.	West	1.6	2.98		
	2 p. m.				29.249	55
	3 p. m.	W.NW	5.1	2.98		
	9 p. m.	North	1.4	2.71	29.484	40
June 1	3 a. m.			2.47		
	7 a. m.			2.50	29.464	53
	9 a. m.			2.50		
	2 p. m.				29.413	63
	3 p. m.			2.45		
	9 p. m.			2.40	29.376	51
2	3 a. m.			2.44		
	7 a. m.				29.266	57
	9 a. m.			2.40		
	2 p. m.				29.130	79
	3 p. m.			2.40		
	9 p. m.			2.43	29.191	67
3	3 a. m.			2.46		
	7 a. m.				29.246	66
	9 a. m.			2.48		
	2 p. m.				29.256	77
	8 p. m.			2.56		
	9 p. m.	NW	1.5	2.51	29.270	67
4	3 a. m.	North	3.5	2.48		
	7 a. m.				29.335	50
	9 a. m.	N. NE	2.1	2.34		
	2 p. m.				29.373	49
	3 p. m.	N. NE	2.5	2.31		
	9 p. m.	N. NE	1.5	2.25	29.393	49
5	3 a. m.	N. NE	1.4	2.31		
	7 a. m.				29.409	50
	9 a. m.	NE	2.3	2.36		
	2 p. m.				29.391	59
	3 p. m.	N. NE	1.4	2.40		
	9 p. m.	Calm	0.0	2.37	29.367	49
6	3 a. m.	Calm	0.0	2.42		
	7 a. m.				29.369	56
	9 a. m.	N. NE	1.4	2.36		
	2 p. m.				29.394	61
	3 p. m.	SE	1.2	2.45		
	9 p. m.	N. NE	0.5	2.34	29.494	54
1861. June 7	3 a. m.	Calm	0.0	2.32		
	7 a. m.				29.466	54
	9 a. m.	N. NE	1.8	2.36		
	2 p. m.				29.458	60
	3 p. m.	N. NE	2.3	2.39		
	9 p. m.	North	1.0	2.37	29.466	55
8	3 a. m.	N.NW	0.2	2.35		
	7 a. m.				29.531	59
	9 a. m.	NE	1.1	2.40		
	2 p. m.				29.531	66
	3 p. m.	NE	1.1	2.39		
	9 p. m.	North	0.4	2.35	29.511	54
9	3 a. m.	Calm	0.0	2.39		
	7 a. m.				29.546	62
	9 a. m.	N. NE	0.4	2.41		
	2 p. m.				29.508	67
	3 p. m.	SE	0.3	2.40		
	9 p. m.	Calm	0.0	2.39	29.476	62
10	3 a. m.	Calm	0.0	2.39		
	7 a. m.				29.468	66
	9 a. m.	SE	0.6	2.46		
	2 p. m.				29.383	76
	3 p. m.	SE	2.2	2.40		
	9 p. m.	Calm	0.0	2.45	29.310	67
11	3 a. m.	SW	0.2	2.45		
	7 a. m.				29.260	77
	9 a. m.	SW	2.4	2.51		
	2 p. m.				29.260	76
	3 p. m.	W. SW	2.8	2.48		
	9 p. m.	West	1.1	2.49	29.305	69
12	3 a. m.	NW	0.5	2.47		
	7 a. m.				29.465	67
	9 a. m.	E. SE	1.1	2.53		
	2 p. m.				29.443	74
	3 p. m.	SE	1.5	2.53		
	9 p. m.	N. NE	2.1	2.46	29.421	67
13	3 a. m.	N. NE	1.5	2.44		
	7 a. m.				29.593	55
	9 a. m.	SE	0.4	2.47		
	2 p. m.				29.563	65
	3 p. m.	SE	0.8	2.43		
	9 p. m.	SE	0.3	2.40	29.463	54
14	3 a. m.	South	0.1	2.39		
	7 a. m.				29.238	67
	9 a. m.	S. SW	4.0	2.40		
	2 p. m.				29.140	65
	3 p. m.	SW	5.7	2.43		
	9 p. m.	SW	4.1	2.34	29.022	78
15	3 a. m.	SW	1.4	2.37		
	7 a. m.				29.050	75
	9 a. m.	W. SW	7.0	2.57		
	2 p. m.				29.002	80
	3 p. m.	W. SW	6.3	2.53		
	9 p. m.	West	4.1	2.42	29.165	67
16	3 a. m.	North	3.0	2.43		
	7 a. m.				29.468	58
	9 a. m.	N. NE	5.7	2.37		
	2 p. m.				29.546	54
	3 p. m.	N. NE	4.1	2.39		
	9 p. m.	North	2.1	2.36	39.551	47
17	3 a. m.	NW	0.7	2.35		
	7 a. m.				29.576	49
	9 a. m.	NE	1.3	2.34		
	2 p. m.				29.526	57
	3 p. m.	SE	1.4	2.43		
	9 p. m.	South	0.3	2.39	29.404	55
18	3 a. m.	SW	0.3	2.46		
	7 a. m.				29.3[illegible]	63
	9 a. m.	SW	1.7	2.46		
	2 p. m.				29.255	77
	3 p. m.	SW	1.3	2.51		
	9 p. m.	Calm	0.0	2.39	29.203	69

TABLE AA.—*Showing the wind, water, barometer, &c.*—Continued.

Date.	Hour of day.	WIND.		Height of water below zero of 1838.	Barometer reduced to 32°.	Therm'r detached.	Date.	Hour of day.	WIND.		Height of water below zero of 1838.	Barometer reduced to 32°.	Therm'r detached.
		Course.	Relative velocity.						Course.	Relative velocity.			
1861.							1861.						
June 19	3 a. m.	S. SW	0. 1	2. 47			July 1	3 a. m.	North	1. 9	2. 30		
	7 a. m.				29. 200	71		7 a. m.				29. 463	54
	9 a. m.	South	0. 8	2. 41				9 a. m.	North	5. 5	2. 27		
	2 p. m.				29. 135	79		2 p. m.				29. 504	58
	3 p. m.	SW	1. 0	2. 35				3 p. m.	N. NE	4. 9	2. 34		
	9 p. m.	SW	0. 2	2. 27	29. 225	73		9 p. m.	North	0. 6	2. 39	29. 601	52
20	3 a. m.	N. NE	1. 0	2. 37			2	3 a. m.			2. 42		
	7 a. m.				29. 251	58		7 a. m.				29. 639	57
	9 a. m.	NE	0. 8	2. 29				9 a. m.	W. NW	1. 5	2. 41		
	2 p. m.				29. 283	59		2 p. m.				29. 576	68
	3 p. m.	SE	1. 5	2. 29				3 p. m.	SE	1. 6	2. 46		
	9 p. m.			2. 16	29. 080	64		9 p. m.	South	0. 1	2. 48	29. 536	63
21	3 a. m.	NW	1. 8	2. 19			3	3 a. m.	Calm	0. 0	2. 53		
	7 a. m.				29. 223	69		7 a. m.				29. 577	66
	9 a. m.	North	1. 5	2. 22				9 a. m.	SW	1. 7	2. 46		
	2 p. m.				29. 298	74		2 p. m.				29. 440	80
	3 p. m.	W. SW	1. 1	2. 39				3 p. m.	SE	1. 9	2. 44		
	9 p. m.	SW	0. 1	2. 40	29. 278	71		9 p. m.	Calm	0. 0	2. 40	29. 421	67
22	3 a. m.	W. NW	1. 0	2. 45			4	3 a. m.	South	0. 2	2. 44		
	7 a. m.				29. 343	70		7 a. m.				29. 391	65
	9 a. m.	NE	1. 4	2. 51				9 a. m.	S. SW	2. 3	2. 40		
	2 p. m.				29. 320	72		2 p. m.				29. 307	85
	3 p. m.	SE	0. 8	2. 45				3 p. m.	SE	2. 7	2. 42		
	9 p. m.	W. SW	0. 2	2. 42	29. 268	68		9 p. m.	South	0. 8	2. 38	29. 272	74
23	3 a. m.	S. SW	1. 0	2. 35			5	3 a. m.	North	0 8	2. 51		
	7 a. m.				29. 308	59		7 a. m.				29. 283	64
	9 a. m.	N. NE	2. 6	2. 40				9 a. m.	SW	1. 7	2. 45		
	2 p. m.				29. 333	63		2 p. m.				29. 255	79
	3 p. m.	N. NE	3. 2	2. 31				3 p. m.	SW	1. 4	2. 45		
	9 p. m.	N. NE	0. 7	2 36	29. 140	55		9 p. m.	S. SE	0. 1	2. 39	29. 230	70
24	3 a. m.	Calm	0. 0	2. 27			6	3 a. m.			2. 46		
	7 a. m.				29. 328	63		7 a. m.				29. 258	75
	9 a. m.	SE	0. 4	2. 32				9 a. m.	SW	0. 4	2. 42		
	2 p. m.				29. 296	67		2 p. m.				29. 210	80
	3 p. m.	SE	1. 2	2. 23				3 p. m.	SW	1. 7	2. 43		
	9 p. m.	SE	0. 3	2. 25	29. 251			9 p. m.	S. SW	1. 4	2. 44	29. 195	73
25	3 a. m.	SW	0. 2	2. 18			7	3 a. m.	S. SW	1. 0	2. 45		
	7 a. m.				29. 245	74		7 a. m.				29. 240	78
	9 a. m.	S. SW	2. 1	2. 32				9 a. m.	S. SW	2. 9			
	2 p. m.				29. 107	80		2 p. m.				29. 224	88
	3 p. m.	SE	1. 9	2. 29				3 p. m.	SW	3. 5			
	9 p. m.	SW	1. 5	2. 37	29. 208	70		9 p. m.	SW	1. 5		29. 224	78
26	3 a. m.	West	1. 9	2. 39			8	3 a. m.	SW	1. 3			
	7 a. m.				29. 351	63		7 a. m.				29. 175	72
	9 a. m.	West	3. 0	2. 52				9 a. m.	SW	2. 2			
	2 p. m.				29. 398	71		2 p. m.				29. 182	77
	3 p. m.	West	3. 0	2. 51				3 p. m.	SW				
	9 p. m.	West	0. 4	2. 50	29. 433	64		9 p. m.	West	1. 6		29. 170	69
27	3 a. m.	West	0. 5	2. 40			9	3 a. m.	W. SW	1. 8			
	7 a. m.				29. 481	65		7 a. m.				29. 208	69
	9 a. m.	SW	0. 7	2. 42				9 a. m.	NW	2. 1	2. 48		
	2 p. m.				29. 465	74		2 p. m.				29. 167	79
	3 p. m.	S. SW	1. 5	2. 46				3 p. m.	N. NE	2. 0	2. 38		
	9 p. m.	SW	0. 5	2. 38	29. 458	66		9 p. m.	North	1. 0	2. 36	29. 150	69
28	3 a. m.	W. SW	1. 0	2. 36			10	3 a. m.	North	2. 7	2. 29		
	7 a. m.				29. 461	67		7 a. m.				29. 291	58
	9 a. m.	E. SE	1. 3	2. 37				9 a. m.	North	2. 9	2. 39		
	2 p. m.				29. 428	68		2 p. m.				29. 343	64
	3 p. m.	East	1. 1	2. 34				3 p. m.	North	3. 8	2. 18		
	9 p. m.	Calm	0. 0	2. 37	29. 428	61		9 p. m.	NW	0. 5	2. 26	29. 366	56
29	3 a. m.	Calm	0. 0	2. 31			11	3 a. m.	Calm	0. 0	2. 24		
	7 a. m.				29. 403	63		7 a. m.				29. 364	59
	9 a. m.	SE	1. 1	2. 38				9 a. m.	SE	0. 7	2. 36		
	2 p. m.				29. 291	71		2 p. m.				29. 284	67
	3 p. m.	SE	1. 5	2. 37				3 p. m.	SE	1. 9	2. 25		
	9 p. m.	Calm	0. 0	2. 41	29. 251	61		9 p. m.	SW	1. 3	2. 33	29. 386	59
30	3 a. m.	West	0. 9	2. 40			12	3 a. m.	North	2. 3	2. 27		
	7 a. m.				29. 256	66		7 a. m.					56
	9 a. m.	NW	1. 8	2. 39				9 a. m.	North	4. 6	2. 22		
	2 p. m.				29. 275	70		2 p. m.				29. 453	62
	3 p. m.	NE	1. 3	2. 33				3 p. m.	North	4. 5	2. 18		
	9 p. m.	North	2. 5	2. 24	29. 338	56		9 p. m.	North	1. 0	2. 23	29. 526	56

TABLE AA.—*Showing the wind, water, barometer, &c.*—Continued.

Date.	Hour of day.	WIND.		Height of water below zero of 1838.	Barometer reduced to 32°.	Therm'r detached.
		Course.	Relative velocity.			
1861.						
July 13	3 a. m.	....	....	2.21	....	....
	7 a. m.	....	....	......	29.516	57
	9 a. m.	NE	1.1	2.27	....	....
	2 p. m.	....	....	......	29.621	63
	3 p. m.	East....	0.5	2.25	....	....
	9 p. m.	Calm ...	0.0	2.29	29.586	59
14	3 a. m.	Calm ...	0.0	2.25	....	....
	7 a. m.	....	....	......	29.536	61
	9 a. m.	S. SW..	1.4	2.26	....	....
	2 p. m.	....	....	......	29.468	70
	3 p. m.	S. SW..	1.2	2.23	....	....
	9 p. m.	S. SW..	1.7	2.24	29.380	65
15	3 a. m.	SW	0.5	2.25	....	....
	7 a. m.	....	....	......	29.296	67
	9 a. m.	NW	1.3	2.26	....	....
	2 p. m.	....	....	......	29.238	77
	3 p. m.	SE	1.6	2.26	....	....
	9 p. m.	East....	0.1	2.29	29.261	64
16	3 a. m.	NW	0.8	2.33	....	....
	7 a. m.	....	....	......	29.281	64
	9 a. m.	NE.....	1.6	2.36	....	....
	2 p. m.	....	....	......	29.221	67
	3 p. m.	SE	1.1	2.43	....	....
	9 p. m.	Calm ...	0.0	2.44	29.316	63
17	3 a. m.	West ...	0.5	2.50	....	...
	7 a. m.	....	....	......	29.346	61
	9 a. m.	West ...	1.6	2.45	....	....
	2 p. m.	....	....	......	29.283	74
	3 p. m.	SW	1.4	2.45	....	....
	9 p. m.	W. SW.	1.2	2.38	29.278	73
18	3 a. m.	SW	0.6	2.42	....	....
	7 a. m.	....	....	......	29.288	69
	9 a. m.	SW	1.5	2.39	....	....
	2 p. m.	....	....	......	29.227	82
	3 p. m.	SW	2.0	2.36	....	....
	9 p. m.	N. NE..	1.1	2.25	29.187	65
19	3 a. m.	N. NW.	0.3	2.31	....	....
	7 a. m.	....	....	......	29.215	63
	9 a. m.	N. NE..	1.4	2.32	....	....
	2 p. m.	....	....	......	29.200	75
	3 p. m.	East....	0.4	2.32	....	....
	9 p. m.	N. NE..	1.1	2.23	29.223	62
20	3 a. m.	N. NW.	0.4	2.37	....	....
	7 a. m.	....	....	......	29.363	61
	9 a. m.	NE.....	1.0	2.39	....	....
	2 p. m.	....	....	......	29.376	70
	3 p. m.	SE	1.3	2.40	....	....
	9 p. m.	East....	0.2	2.40	29.403	60
21	3 a. m.	Calm ...	0.0	2.40	....	....
	7 a. m.	....	....	......	29.443	62
	9 a. m.	E. SE ..	1.0	2.36	....	....
	2 p. m.	....	....	......	29.438	65
	3 p. m.	East....	1.5	2.30	....	....
	9 p. m.	N. NE..	0.4	2.30	29.486	57
22	3 a. m.	N. NW.	0.5	2.23	....	....
	7 a. m.	....	....	......	29.539	57
	9 a. m.	N. NE..	4.1	2.28	....	....
	2 p. m.	....	....	......	29.556	63
	3 p. m.	North ..	4.3	2.26	....	....
	9 p. m.	N. NW.	0.8	2.30	29.526	56
23	3 a. m.	Calm ...	0.0	2.29	....	....
	7 a. m.	....	....	......	29.571	59
	9 a. m.	E. SE ..	0.9	2.39	....	....
	2 p. m.	....	....	......	29.533	71
	3 p. m.	SE	1.5	2.34	....	....
	9 p. m.	Calm ...	0.0	2.37	29.523	62
	3 a. m.	Calm ...	0.0	2.35	....	....
	7 a. m.	....	....	......	29.406	61
	9 a. m.	SW	1.2	2.40	....	....
	2 p. m.	....	....	......	29.451	65
	3 p. m.	SE	2.0	2.31	....	....
	9 p. m.	S. SE ..	1.6	2.41	29.373	64
1861.						
July 25	3 a. m.	SW	1.8	2.43	....	....
	7 a. m.	....	....	......	29.323	69
	9 a. m.	SW	3.6	2.45	....	....
	2 p. m.	....	....	......	29.259	84
	3 p. m.	SW	3.2	2.41	....	....
	9 p. m.	SW	0.8	2.43	29.257	75
26	3 a. m.	SW	1.1	2.33	....	....
	7 a. m.	....	....	......	29.258	71
	9 a. m.	W. SW.	1.1	2.40	....	....
	2 p. m.	....	....	......	29.280	79
	3 p. m.	....	....	2.39	....	....
	9 p. m.	....	....	2.35	29.328	69
27	3 a. m.	....	....	2.34	....	....
	7 a. m.	....	....	......	29.338	64
	9 a. m.	E. SE ..	0.5	2.37	....	....
	2 p. m.	....	....	......	29.333	67
	3 p. m.	East....	1.6	2.16	....	....
	9 p. m.	SE	1.5	2.11	29.027	65
28	3 a. m.	NW	3.0	2.03	....	....
	7 a. m.	....	....	......	29.062	64
	9 a. m.	NW	4.3	1.97	....	....
	2 p. m.	....	....	......	29.361	71
	3 p. m.	NW	2.8	1.93	....	....
	9 p. m.	Calm ...	0.0	1.99	29.225	66
29	3 a. m.	Calm ...	0.0	2.13	....	....
	7 a. m.	....	....	......	29.321	63
	9 a. m.	SW	1.0	2.23	....	....
	2 p. m.	....	....	......	29.303	75
	3 p. m.	SE	1.4	2.31	....	....
	9 p. m.	SW	0.8	2.28	29.233	71
30	3 a. m.	SW	0.9	2.25	....	....
	7 a. m.	....	....	......	29.293	72
	9 a. m.	SE	1.2	2.21	....	....
	2 p. m.	....	....	......	29.231	90
	3 p. m.	SW	2.8	2.12	....	....
	9 p. m.	SW	1.9	2.08	29.221	82
31	3 a. m.	SW	2.5	2.04	....	....
	7 a. m.	....	....	......	29.247	79
	9 a. m.	W. SW	3.0	2.15	....	....
	2 p. m.	....	....	......	29.206	93
	3 p. m.	SW	2.1	2.06	....	....
	9 p. m.	SW	0.5	2.01	29.211	83
Aug. 1	3 a. m.	W. SW	1.6	1.95	....	....
	7 a. m.	....	....	......	29.299	81
	9 a. m.	W. SW	1.6	2.06	....	....
	2 p. m.	....	....	......	29.333	96
	3 p. m.	SW	1.6	2.18	....	....
	9 p. m.	SW	0.4	2.14	29.231	85
2	3 a. m.	SW	0.8	2.19	....	....
	7 a. m.	....	....	......	29.267	82
	9 a. m.	West ...	2.5	2.23	....	....
	2 p. m.	....	....	......	29.255	92
	3 p. m.	North ..	1.3	2.20	....	....
	9 p. m.	NE.....	0.4	2.19	29.319	75
3	3 a. m.	North ..	0.6	2.23	....	....
	7 a. m.	....	....	......	29.370	68
	9 a. m.	North ..	1.3	2.20	....	....
	2 p. m.	....	....	......	29.330	76
	3 p. m.	SE	0.5	2.18	....	....
	9 p. m.	SE	0.1	2.10	29.288	71
4	3 a. m.	S. SW..	0.1	2.15	....	....
	7 a. m.	....	....	......	29.217	79
	9 a. m.	W. SW.	2.2	2.19	....	....
	2 p. m.	....	....	......	29.166	95
	3 p. m.	West ..	3.2	2.14	....	....
	9 p. m.	North ..	2.1	2.18	29.254	93
5	3 a. m.	North ..	1.4	2.21	....	....
	7 a. m.	....	....	......	29.335	70
	9 a. m.	N. NE ..	2.2	2.24	....	....
	2 p. m.	....	....	......	29.322	78
	3 p. m.	E. SE ..	0.8	2.21	....	....
	9 p. m.	Calm ...	0.0	2.20	29.335	67

TABLE AA.—*Showing the wind, water, barometer, &c.*—Continued.

Date.	Hour of day.	Wind.		Height of water below zero of 1838.	Barometer reduced to 32°.	Therm'r detached.	Date.	Hour of day.	Wind.		Height of water below zero of 1838.	Barometer reduced to 32°.	Therm'r detached.
		Course.	Relative velocity.						Course.	Relative velocity.			
1861. Aug. 6	3 a. m.	Calm	0.0	2.17			1861. Aug. 18	3 a. m.	Calm	0.0	2.21		
	7 a. m.				29.320	70		7 a. m.				29.504	67
	9 a. m.	S. SE	0.4	2.18				9 a. m.	SE	1.4	2.16		
	2 p. m.				29.272	80		2 p. m.				29.440	75
	3 p. m.	SE	1.0	2.12				3 p. m.	SE	2.1	2.15		
	9 p. m.	North	0.9	2.05	29.463	74		9 p. m.	South	0.1	2.06	29.420	72
7	3 a. m.	NE	1.1	1.99			19	3 a. m.	NW	0.3	2.08		
	7 a. m.				29.255	68		7 a. m.				29.495	66
	9 a. m.	E. NE	1.4	2.01				9 a. m.	North	1.3	2.09		
	2 p. m.				29.238	71		2 p. m.				29.485	71
	3 p. m.	North	3.0	1.95				3 p. m.	NE	2.4	2.06		
	9 p. m.	North	2.0	1.94	29.285	66		9 p. m.	North	0.3	2.03	29.539	62
8	3 a. m.	N. NE	0.4	2.03			20	3 a. m.	North	0.7	2.04		
	7 a. m.				29.268	70		7 a. m.				29.563	63
	9 a. m.	NE	0.3	1.96				9 a. m.	N. NE	1.7	2.09		
	2 p. m.				29.260	71		2 p. m.				29.533	69
	3 p. m.	North	2.7	1.89				3 p. m.	East	0.8	2.10		
	9 p. m.	North	1.5	1.94	29.300	66		9 p. m.	SE	0.1	2.13	29.518	64
9	3 a. m.	N. NW	0.9	1.92			21	3 a. m.	South	0.3	2.13		
	7 a. m.				29.328	67		7 a. m.				29.423	66
	9 a. m.	N. NE	1.9	2.08				9 a. m.	NW	0.5	2.20		
	2 p. m.				29.330	72		2 p. m.				29.330	72
	3 p. m.	E. SE	0.8	2.06				3 p. m.	NE	1.0	2.11		
	9 p. m.	Calm	0.0	2.19	29.275	67		9 p. m.	North	1.9	2.17	29.408	65
10	3 a. m.	W. NW	0.1	2.12			22	3 a. m.	NW	0.7	2.17		
	7 a. m.				29.233	67		7 a. m.				29.488	60
	9 a. m.	N. NE	2.5	2.16				9 a. m.	N. NE	3.2	2.22		
	2 p. m.				29.268	70		2 p. m.				29.553	66
	3 p. m.	N. NE	4.3	2.01				3 p. m.	NE	2.0	2.20		
	9 p. m.	N. NE	3.9	1.99	29.303	64		9 p. m.	Calm	0.0	2.28	29.588	57
11	3 a. m.	N. NE	3.4	1.89			23	3 a. m.	Calm	0.0	2.30		
	7 a. m.				29.328	62		7 a. m.				29.621	58
	9 a. m.	NE	2.7	1.90				9 a. m.	W. NW	0.6	2.31		
	2 p. m.				29.310	66		2 p. m.				29.591	70
	3 p. m.	N. NE	5.2	1.74				3 p. m.	SE	1.9	2.25		
	9 p. m.	NE	3.6	1.73	29.311	65		9 p. m.	Calm	0.0	2.30	29.581	62
12	3 a. m.	NE	3.9	1.73			24	3 a. m.	Calm	0.0	2.25		
	7 a. m.				29.266	57		7 a m.				29.596	58
	9 a. m.	NE	3.9	1.72				9 a. m.	W. SW	1.0	2.29		
	2 p. m.				29.336	63		2 p. m.				29.565	71
	3 p. m.	N. NE	6.2	1.72				3 p. m.	SE	2.3	2.23		
	9 p. m.	N. NE	4.0	1.73	29.418	60		9 p. m.	Calm	0.0	2.26	29.514	65
13	3 a. m.	N. NE	2.7	1.74			25	3 a. m.	Calm	0.0	2.23		
	7 a. m.				28.551	56		7 a. m.				27.531	62
	9 a. m.	N. NE	3.3	1.89				9 a. m.	SW	0.3	2.29		
	2 p. m.				29.576	63		2 p. m.				29.463	71
	3 p. m.	N. NE	3.7	1.89				3 p. m.	SE	0.8	2.27		
	9 p. m.	N. NE	1.0	1.98	29.598	55		9 p. m.	S. SW	0.1	2.31	29.451	62
14	3 a. m.	Calm	0.0	2.02			26	3 a. m.	Calm	0.0	2.35		
	7 a. m.				29.621	54		7 a. m.				29.448	61
	9 a. m.	E. SE	0.8	2.05				9 a. m.	SW	1.8	2.39		
	2 p. m.				29.601	67		2 p. m.				29.400	77
	3 p. m.	SE	2.3	2.06				3 p. m.	SW	0.8	2.40		
	9 p. m.	SE	0.3	2.03	29.576	63		9 p. m.	SW	0.8	2.44	29.368	70
15	3 a. m.			2.10			27	3 a. m.	SW	1.0	2.48		
	7 a. m.				29.543	61		7 a. m.				29.385	63
	9 a. m.	SW	1.9	2.13				9 a. m.	W. NW	1.6	2.42		
	2 p. m.				29.478	73		2 p. m.				29.390	74
	3 p. m.	SW	2.1	2.23				3 p. m.	SE	1.5	2.35		
	9 p. m.	S. SW	0.7	2.20		65		9 p. m.	Calm	0.0	2.32	29.425	66
16	3 a. m.	W. SW	0.7	2.26			28	3 a. m.	Calm	0.0	2.34		
	7 a. m.				29.433	64		7 a. m.				29.443	61
	9 a. m.	West	2.2	2.20				9 a. m.	W. NW	1.0	2.35		
	2 p. m.				29.415	77		2 p. m.				29.443	73
	3 p. m.	NE	1.3	2.19				3 p. m.	W. SW	1.2	2.34		
	9 p. m.	Calm	0.0	2.11	29.460	65		9 p. m.	West	0.5	2.33	29.435	65
17	3 a. m.	Calm	0.0	2.13			29	3 a. m.	W. NW	0.5	2.35		
	7 a. m.				29.473	62		7 a. m.				29.471	59
	9 a. m.	SE	0.9	2.17				9 a. m.	NE	0.9	2.35		
	2 p. m.				29.480	72		2 p. m.				29.478	70
	3 p. m.	SE	2.4	2.20				3 p. m.	E. SE	1.2	2.33		
	9 p. m.	Calm	0.0	2.20	29.463	68		9 p. m.	Calm	0.0	2.35	29.471	63

TABLE AA.—*Showing the wind, water, barometer, &c.*—Continued.

Date.	Hour of day.	WIND.		Height of water below zero of 1838.	Barometer reduced to 32°.	Therm'r detached.	Date.	Hour of day.	WIND.		Height of water below zero of 1838.	Barometer reduced to 32°.	Therm'r detached.
		Course.	Relative velocity.						Course.	Relative velocity.			
1861. Aug. 30	3 a.m.	West	0.5	2.28	....	....	1861. Sept. 11	3 a.m.	NW	0.4	2.17	....	....
	7 a.m.	....	....	......	29.523	57		7 a.m.	....	....	......	29.303	61
	9 a.m.	N.NE	1.7	2.35	....	....		9 a.m.	West	0.1	2.24	....	....
	2 p.m.	....	....	......	29.546	67		2 p.m.	....	....	......	29.306	66
	3 p.m.	E.NE	1.7	2.35	....	....		3 p.m.	North	0.2	2.34	....	....
	9 p.m.	East	0.2	2.32	29.526	63		9 p.m.	Calm	0.0	2.41	29.333	62
31	3 a.m.	SE	0.9	2.33	....	....	12	3 a.m.	West	0.3	3.50	....	....
	7 a.m.	....	....	......	29.523	65		7 a.m.	....	....	......	29.386	57
	9 a.m.	SE	2.2	2.31	....	....		9 a.m.	SW	1.0	2.54	....	....
	2 p.m.	....	....	......	29.450	71		2 p.m.	....	....	......	29.368	70
	3 p.m.	SE	2.6	2.29	....	....		3 p.m.	SW	1.2	2.52	....	....
	9 p.m.	SE	1.0	2.20	29.398	69		9 p.m.	SW	0.2	2.54	29.343	60
Sept. 1	3 a.m.	S.SW	0.7	2.31	....	....	13	3 a.m.	SW	0.5	2.56	....	....
	7 a.m.	....	....	......	29.325	67		7 a.m.	....	....	......	29.358	62
	9 a.m.	SW	1.4	2.30	....	....		9 a.m.	SW	2.0	2.57	....	....
	2 p.m.	....	....	......	29.258	69		2 p.m.	....	....	......	29.308	75
	3 p.m.	S.SW	2.0	2.33	....	....		3 p.m.	SE	1.6	2.58	....	....
	9 p.m.	Calm	0.0	2.25	29.305	67		9 p.m.	E.SE	1.0	2.49	29.295	65
2	3 a.m.	SE	0.9	2.35	....	....	14	3 a.m.	SW	0.4	2.47	....	....
	7 a.m.	....	....	......	29.308	65		7 a.m.	....	....	......	29.208	68
	9 a.m.	SE	1.1	2.39	....	....		9 a.m.	North	1.5	2.40	....	....
	2 p.m.	....	....	......	29.235	75		2 p.m.	....	....	......	29.260	78
	3 p.m.	E.NE	1.1	2.56	....	....		3 p.m.	E.SE	0.8	2.43	....	....
	9 p.m.	Calm	0.0	2.39	29.285	66		9 p.m.	NE	0.2	2.35	29.424	69
3	3 a.m.	West	0.5	2.50	....	....	15	3 a.m.	North	2.7	......	....	....
	7 a.m.	....	....	......	29.453	62		7 a.m.	....	....	......	29.590	61
	9 a.m.	NW	3.0	2.50	....	....		9 a.m.	North	3.9	......	....	....
	2 p.m.	....	....	......	29.483	73		2 p.m.	....	....	......	29.628	63
	3 p.m.	NW	1.7	2.49	....	....		3 p.m.	N.NE	3.4	......	....	....
	9 p.m.	Calm	0.0	2.44	29.595	62		9 p.m.	NE	1.2	......	29.616	60
4	3 a.m.	E.NE	1.4	2.44	....	....	16	3 a.m.	E.NE	0.6	......	....	....
	7 a.m.	....	....	......	29.691	62		7 a.m.	....	....	......	29.563	60
	9 a.m.	SE	1.3	2.47	....	....		9 a.m.	NE	1.1	......	....	....
	2 p.m.	....	....	......	29.649	65		2 p.m.	....	....	......	29.436	62
	3 p.m.	SE	1.5	2.42	....	....		3 p.m.	E.NE	1.1	......	....	....
	9 p.m.	Calm	0.0	2.37	29.646	59		9 p.m.	North	2.4	......	29.343	61
5	3 a.m.	Calm	0.0	2.34	....	....	17	3 a.m.	....	....	......	....	....
	7 a.m.	....	....	......	29.421	57		7 a.m.	....	....	......	29.381	55
	9 a.m.	SW	2.0	2.51	....	....		9 a.m.	N.NE	1.8	......	....	....
	2 p.m.	....	....	......	29.263	71		2 p.m.	....	....	......	29.366	64
	3 p.m.	SW	2.4	2.54	....	....		3 p.m.	E.SE	0.7	......	....	....
	9 p.m.	W.NW	0.6	2.53	29.191	65		9 p.m.	S.SE	0.1	......	29.326	63
6	3 a.m.	West	0.6	2.58	....	....	18	3 a.m.	S.SW	0.8	......	....	....
	7 a.m.	....	....	......	29.221	58		7 a.m.	....	....	......	29.241	60
	9 a.m.	West	2.9	2.61	....	....		9 a.m.	SW	2.8	......	....	....
	2 p.m.	....	....	......	29.278	65		2 p.m.	....	....	......	29.140	79
	3 p.m.	West	2.1	2.53	....	....		3 p.m.	S.SW	3.4	......	....	....
	9 p.m.	NW	1.7	2.48	29.356	60		9 p.m.	South	3.1	......	29.104	73
7	3 a.m.	North	2.8	2.31	....	....	19	3 a.m.	SW	3.0	......	....	....
	7 a.m.	....	....	......	29.571	56		7 a.m.	....	....	......	29.135	73
	9 a.m.	N.NE	3.3	2.31	....	....		9 a.m.	W.SW	2.2	......	....	....
	2 p.m.	....	....	......	29.611	58		2 p.m.	....	....	......	29.210	75
	3 p.m.	N.NE	3.4	2.27	....	....		3 p.m.	E.NE	1.5	2.56	....	....
	9 p.m.	NW	1.4	2.23	29.682	54		9 p.m.	North	0.6	2.51	29.300	63
8	3 a.m.	East	1.7	2.22	....	....	20	3 a.m.	East	1.1	2.45	....	....
	7 a.m.	....	....	......	29.730	58		7 a.m.	....	....	......	29.248	59
	9 a.m.	NE	1.7	2.33	....	....		9 a.m.	N.NE	2.8	2.20	....	....
	2 p.m.	....	....	......	29.729	62		2 p.m.	....	....	......	29.163	58
	3 p.m.	NE	2.2	2.28	....	....		3 p.m.	North	4.4	1.97	....	....
	9 p.m.	E.NE	0.4	2.38	29.729	57		9 p.m.	North	3.5	2.05	29.333	54
9	3 a.m.	Calm	0.0	2.34	....	....	21	3 a.m.	North	2.2	2.03	....	....
	7 a.m.	....	....	......	29.745	55		7 a.m.	....	....	......	29.514	46
	9 a.m.	E.SE	1.4	2.38	....	....		9 a.m.	N.NW	1.5	2.18	....	....
	2 p.m.	....	....	......	29.692	64		2 p.m.	....	....	......	29.504	45
	3 p.m.	SE	1.3	2.35	....	....		3 p.m.	E.SE	0.5	2.22	....	....
	9 p.m.	E.SE	1.5	2.37	29.588	62		9 p.m.	Calm	0.0	2.37	29.491	51
10	3 a.m.	SE	1.3	2.33	....	....	22	3 a.m.	Calm	0.0	2.40	....	....
	7 a.m.	....	....	......	29.428	63		7 a.m.	....	....	......	29.374	47
	9 a.m.	SE	1.3	2.31	....	....		9 a.m.	W.SW	2.7	2.56	....	....
	2 p.m.	....	....	......	29.248	64		2 p.m.	....	....	......	29.263	70
	3 p.m.	E.SE	1.6	2.12	....	....		3 p.m.	W.SW	2.6	2.46	....	....
	9.p.m.	North	1.3	2.15	29.236	62		9 p.m.	West	1.1	2.52	29.308	61

TABLE AA.—*Showing the wind, water, barometer, &c.*—Continued.

Date.	Hour of day.	WIND.		Height of water below zero of 1838.	Barometer reduced to 32°.	Therm'r detached.
		Course.	Relative velocity.			
1861. Sept. 23	3 a. m.	W. NW	0.8	2.44		
	7 a. m.				29.406	51
	9 a. m.	W. NW	0.9	2.46		
	2 p. m.				29.406	65
	3 p. m.	SE	0.8	2.36		
	9 p. m.	Calm	0.0	2.37	29.393	64
24	3 a. m.	Calm	0.0	2.34		
	7 a. m.				29.424	56
	9 a. m.	S. SW	1.9	2.40		
	2 p. m.				29.328	72
	3 p. m.	South	2.7	2.39		
	9 p. m.	South	1.2	2.46	29.298	65
25	3 a. m.	S. SW	0.5	2.44		
	7 a. m.				29.228	60
	9 a. m.	SW	1.2	2.47		
	2 p. m.				29.156	64
	3 p. m.	S. SW	2.0	2.47		
	9 p. m.	West	1.3	2.42	29.176	55
26	3 a. m.	W. SW	0.7	2.39		
	7 a. m.				29.157	48
	9 a. m.	W. SW	2.2	2.44		
	2 p. m.				29.156	55
	3 p. m.	W. SW	2.3	2.54		
	9 p. m.	W. SW	1.0	2.57	29.188	49
27	3 a. m.	West	0.4	2.55		
	7 a. m.				29.204	45
	9 a. m.	N. NW	2.6	2.53		
	2 p. m.				29.179	50
	3 p. m.	NW	2.4	2.54		
	9 p. m.	W. NW	1.3	2.50	29.288	46
28	3 a. m.	NW	0.7	2.53		
	7 a. m.				29.344	41
	9 a. m.	W. NW	2.0	2.51		
	2 p. m.				29.431	51
	3 p. m.	W. SW	1.5	2.56		
	9 p. m.	W. SW	0.2	2.48	29.519	44
29	3 a. m.	W. SW	0.5	2.57		
	7 a. m.				29.640	45
	9 a. m.	NW	0.7	2.47		
	2 p. m.				29.702	53
	3 p. m.	North	0.2	2.47		
	9 p. m.	N. NE	0.4	2.36	29.755	48
30	3 a. m.			2.38		
	7 a. m.				29.815	46
	9 a. m.	N. NE	1.0	2.30		
	2 p. m.				29.774	55
	3 p. m.	SE	1.8	2.36		
	9 p. m.	SE	2.6	2.29	29.692	55
Oct. 1	3 a. m.	SE	2.4	2.31		
	7 a. m.				29.499	56
	9 a. m.			2.30		
	2 p. m.				29.308	65
	3 p. m.	S. SE	1.9	2.35		
	9 p. m.	SE	2.8	2.33	29.218	65
2	3 a. m.	SW	2.6	2.40		
	7 a. m.				29.186	62
	9 a. m.	W. SW	3.1	2.48		
	2 p. m.				29.218	66
	3 p. m.	W. SW	3.8	3.60		
	9 p. m.	NW	1.0	2.63	29.391	53
3	3 a. m.	Calm	0.0	2.71		
	7 a. m.				29.504	44
	9 a. m.	NE	0.8	2.69		
	2 p. m.				29.463	52
	3 p. m.	NE	2.0	2.49		
	9 p. m.	E. NE	1.6	2.37	29.331	54
4	3 a. m.	NE	1.0	2.27		
	7 a. m.				29.326	56
	9 a. m.	N. NE	0.6	2.22		
	2 p. m.				29.218	58
	3 p. m.	E. NE	1.1	2.14		
	9 p. m.	East	0.1	2.17	29.198	59
1861. Oct. 5	3 a. m.	SW	0.7	2.13		
	7 a. m.				29.113	62
	9 a. m.	W. NW	2.9	2.29		
	2 p. m.				29.181	60
	3 p. m.	West	2.1	2.34		
	9 p. m.	NW	0.3	2.42	29.258	51
6	3 a. m.	NW	0.4	2.40		
	7 a. m.				29.252	47
	9 a. m.	NW	0.4	2.45		
	2 p. m.				29.279	57
	3 p. m.	SE	1.5	2.38		
	9 p. m.	SW	0.3	2.45	29.354	51
7	3 a. m.	SW	1.5	2.44		
	7 a. m.				29.397	54
	9 a. m.	S. SW	2.0	2.44		
	2 p. m.				29.351	65
	3 p. m.	S. SW	2.0	2.42		
	9 p. m.	SW	0.3	2.42	29.377	54
8	3 a. m.	SW	0.1	2.44		
	7 a. m.				29.471	48
	9 a. m.	South	0.9	2.44		
	2 p. m.				29.428	70
	3 p. m.	SW	2.2	2.41		
	9 p. m.	South	1.2	2.42	29.448	60
9	3 a. m.	S. SW	0.5	2.38		
	7 a. m.				29.531	55
	9 a. m.	South	1.9	2.40		
	2 p. m.				29.458	62
	3 p. m.	SE	2.0	2.46		
	9 p. m.	S. SE	0.2	2.38	29.416	57
10	3 a. m.	Calm	0.0	2.38		
	7 a. m.				29.386	52
	9 a. m.	SE	1.2	2.35		
	2 p. m.				29.263	63
	3 p. m.	South	2.1	2.36		
	9 p. m.	West	3.0	2.42	29.258	49
11	3 a. m.	W. SW	2.3	2.44		
	7 a. m.				29.294	41
	9 a. m.	W. SW	0.4	2.56		
	2 p. m.				29.297	53
	3 p. m.	SW	3.2	2.69		
	9 p. m.	SW	3.0	2.81	29.040	50
12	3 a. m.	West	1.1	2.70		
	7 a. m.				29.046	42
	9 a. m.	NW	4.2	2.77		
	2 p. m.				29.088	52
	3 p. m.	W. NW	3.2	2.66		
	9 p. m.	Calm	0.0	2.63	29.234	44
13	3 a. m.	NW	0.3	2.75		
	7 a. m.				29.342	38
	9 a. m.	West	0.3	2.72		
	2 p. m.				29.359	51
	3 p. m.	SE	0.9	2.67		
	9 p. m.	Calm	0.0	2.64	29.334	46
14	3 a. m.	W. SW	0.7	2.65		
	7 a. m.				29.292	52
	9 a. m.	N. NE	3.4	2.44		
	2 p. m.				29.384	56
	3 p. m.	N. NE	1.1	2.54		
	9 p. m.	Calm	0.0	2.49	29.404	46
15	3 a. m.	Calm	0.0	2.50		
	7 a. m.				29.387	44
	9 a. m.	SW	0.3	2.41		
	2 p. m.				29.351	66
	3 p. m.	Calm	0.0	2.40		
	9 p. m.	Calm	0.0	2.31	29.357	62
16	3 a. m.	SW	1.4	2.36		
	7 a. m.				29.356	59
	9 a. m.	SW	0.5	2.35		
	2 p. m.				29.311	64
	3 p. m.	S. SW	1.8	2.49		
	9 p. m.	Calm	0.0	2.44	29.291	59

TABLE AA.—*Showing the wind, water, barometer, &c.*—Continued.

Date.	Hour of day.	WIND.		Height of water below zero of 1838.	Barometer reduced to 62°.	Therm'r detached.
		Course.	Relative velocity.			
1861.						
Oct. 17	3 a. m.	Calm	0.0	2.48		
	7 a. m.				29.284	56
	9 a. m.	N.NE	2.5	2.39		
	2 p. m.				29.301	50
	3 p. m.	N.NE	5.4	2.28		
	9 p. m.	North	5.2	2.21	29.368	48
18	3 a. m.	North	4.0	2.18		
	7 a. m.				29.374	46
	9 a. m.	North	3.0	2.25		
	2 p. m.				29.324	50
	3 p. m.	NE	1.9	2.29		
	9 p. m.	W.SW	0.3	2.43	29.318	43
19	3 a. m.	W.SW	1.8	2.51		
	7 a. m.				29.297	44
	9 a. m.	W. NW.	3.6	2.61		
	2 p. m.				29.312	58
	3 p. m.	West	3.4	2.65		
	9 p. m.	W.SW	0.5	2.70	29.416	48
20	3 a. m.	W.NW	0.1	2.68		
	7 a. m.				29.557	37
	9 a. m.	South	0.4	2.71		
	2 p. m.				29.534	54
	3 p. m.	SE	1.4	2.59		
	9 p. m.	SE	0.8	2.49	29.489	49
21	3 a. m.	S.SE	1.0	2.42		
	7 a. m.				29.477	45
	9 a. m.	SE	1.6	2.42		
	2 p. m.				29.349	54
	3 p. m.	SE	1.4	2.33		
	9 p. m.	Calm	0.0	2.33	29.293	48
22	3 a. m.	Calm	0.0	2.31		
	7 a. m.				29.207	44
	9 a. m.	West	2.0	2.46		
	2 p. m.				29.229	48
	3 p. m.	NW	2.9	2.50		
	9 p. m.	West	2.7	2.67	29.314	40
23	3 a. m.	W.NW	2.3	2.71		
	7 a. m.				29.337	39
	9 a. m.	W.NW	2.2	2.77		
	2 p. m.				29.389	41
	3 p. m.	NW	2.4	2.77		
	9 p. m.	West	0.8	2.77	29.547	36
24	3 a. m.	Calm	0.0	2.70		
	7 a. m.				29.660	31
	9 a. m.	S.SW	0.8	2.70		
	2 p. m.				29.571	51
	3 p. m.	South	1.7	2.63		
	9 p. m.	South	1.5	2.75	29.543	45
25	3 a. m.	S.SW	2.0	2.78		
	7 a. m.				29.462	43
	9 a. m.	SW	2.1	2.83		
	2 p. m.				29.466	59
	3 p. m.	SW	0.9	2.78		
	9 p. m.	Calm	0.0	2.78	29.528	50
26	3 a. m.	West	0.1	2.82		
	7 a. m.				29.644	39
	9 a. m.	NW	1.2	2.76		
	2 p. m.				29.682	50
	3 p. m.	NW	1.4	2.69		
	9 p. m.	Calm	0.0	2.67	29.744	36
27	3 a. m.	Calm	0.0	2.72		
	7 a. m.				29.786	29
	9 a. m.	Calm	0.0	2.64		
	2 p. m,				29.662	49
	3 p. m.	SE	2.3	2.71		
	9 p. m.	South	0.1	2.69	29.559	42
28	3 a. m.	SW	0.1	2.74		
	7 a. m.				29.447	38
	9 a. m.	S.SW	1.6	2.78		
	2 p. m.				29.316	55
	3 p. m.	SE	2.0	2.75		
	9 p. m.	South	1.7	2.59	29.224	51
29	3 a. m.	South	1.6	2.65		
1861.						
Oct. 29	7 a. m.				28.863	46
	9 a. m.	SW	3.4	2.64		
	2 p. m.				28.718	43
	3 p. m.	S.SW	3.8	2.61		
	9 p. m.	West	2.8	2.44	28.658	39
30	3 a. m.	West	2.3	2.57		
	7 a. m.				28.826	42
	9 a. m.	West	3.9	2.65		
	2 p. m.				28.966	45
	3 p. m.	West	3.2	2.74		
	9 p. m.		2.0	2.71	29.169	40
31	3 a. m.	West	1.4	2.76		
	7 a. m.				29.392	38
	9 a. m.	W.NW	1.0	2.70		
	2 p. m.				29.484	43
	3 p. m.	W.SW	0.1	2.74		
	9 p. m.	Calm	0.0	2.60	29.564	42
Nov. 1	3 a. m.	N.NE	0.5	2.66		
	7 a. m.				29.617	44
	9 a. m.	NE	1.9	2.57		
	2 p. m.				29.546	46
	3 p. m.	NE	3.0	2.50		
	9 p. m.	NE	1.8	2.40	29.458	45
2	3 a. m.	NE	3.4	2.37		
	7 a. m.				29.317	45
	9 a. m.	N.NE	4.5	2.31		
	2 p. m.				29.251	45
	3 p. m.	North	4.7	2.24		
	9 p. m.	North	2.0	2.36	29.254	41
3	3 a. m.	N.NW	1.4	2.49		
	7 a. m.				29.220	37
	9 a. m.	NW	2.4	2.65		
	2 p. m.				29.171	44
	3 p. m.	West	2.4	2.76		
	9 p. m.	West	0.6	2.85	29.186	37
4	3 a. m.			2.88		
	7 a. m.				29.192	33
	9 a. m.			2.94		
	2 p. m.				29.043	52
	3 p. m.	S.SW	0.6	2.90		
	9 p. m.	W.SW	1.0	2.93	28.996	45
5	3 a. m.	West	0.3	2.81		
	7 a. m.				29.036	39
	9 a. m.	SW	0.4	2.84		
	2 p. m.				28.863	51
	3 p. m.	S.SW	0.9	2.71		
	9 p. m.	Calm	0.0	2.74	28.891	44
6	3 a. m.	W.NW	0.9	2.79		
	7 a. m.				29.169	37
	9 a. m.	NW	2.3	2.77		
	2 p. m.				29.298	47
	3 p. m.	W.NW	1.7	2.80		
	9 p. m.	Calm	0.0	2.85	29.374	38
7	3 a. m.	Calm	0.0	2.88		
	7 a. m.				29.385	35
	9 a. m.	S.SW	1.0	2.90		
	2 p. m.				29.234	53
	3 p. m.	SW	1.0	2.87		
	9 p. m.	Calm	0.0	2.75	29.199	44
8	3 a. m.	NW	0.5	2.68		
	7 a. m.				29.202	44
	9 a. m.	North	2.7	2.58		
	2 p. m.				29.250	45
	3 p. m.	NE	0.6	2.67		
	9 p. m.	Calm	0.0	2.74	29.318	37
9	3 a. m.	Calm	0.0	2.82		
	7 a. m.				29.370	29
	9 a. m.	Calm	0.0	2.89		
	2 p. m.				29.294	44
	3 p. m.	S.SW	0.5	2.90		
	9 p. m.	S.SW	0.2	2.89	29.221	42
10	3 a. m.	South	0.4	2.88		
	7 a. m.				29.001	44

TABLE AA.—*Showing the wind, water, barometer, &c.*—Continued.

Date.	Hour of day.	Wind.		Height of water below zero of 1838.	Barometer reduced to 32°.	Therm'r detached.	Date.	Hour of day.	Wind.		Height of water below zero of 1838.	Barometer reduced to 32°.	Therm'r detached.
		Course.	Relative velocity.						Course.	Relative velocity.			
1861. Nov. 10	9 a. m.	South	3.5	2.79	......	...	1861. Nov. 20	3 p. m.	W.SW	3.2	2.72	......	...
	2 p. m.	......	...	......	28.800	54		9 p. m.	W.SW	1.0	2.83	29.326	41
	3 p. m.	SW	3.3	2.81	......	...	21	3 a. m.	W.SW	0.2	2.81	......	...
	9 p. m.	West	3.1	2.64	28.998	47		7 a. m.	......	...	......	29.501	32
11	3 a. m.	West	2.4	2.87	......	...		9 a. m.	SE.	0.5	2.94	......	...
	7 a. m.	......	...	......	29.335	39		2 p. m.	......	...	......	29.441	45
	9 a. m.	West	3.4	2.92	......	...		3 p. m.	S.SE	2.3	2.90	......	...
	2 p. m.	......	...	......	29.536	46		9 p. m.	S.SE	2.4	2.93	29.334	45
	3 p. m.	West	0.6	3.04	......	...	22	3 a. m.	S.SE	2.4	2.78	......	...
	9 p. m.	Calm	0.0	3.06	29.604	35		7 a. m.	......	...	......	29.063	45
12	3 a. m.	Calm	0.0	3.04	......	...		9 a. m.	S.SE	2.2	2.78	......	...
	7 a. m.	......	...	......	29.570	35		2 p. m.	......	...	......	28.891	36
	9 a. m.	SE.	1.5	2.89	......	...		3 p. m.	West	3.5	2.67	......	...
	2 p. m.	......	...	......	29.349	48		9 p. m.	W.SW	3.9	2.73	28.856	30
	3 p. m.	SE.	0.8	2.81	......	...	23	3 a. m.	W.SW	4.2	2.86	......	...
	9 p. m.	Calm	0.0	2.64	20.318	47		7 a. m.	......	...	......	28.751	21
13	3 a. m.	Calm	0.0	2.68	......	...		9 a. m.	W.SW	4.4	3.00	......	...
	7 a. m.	......	...	......	29.467	38		2 p. m.	......	...	......	28.703	25
	9 a. m.	NW	0.7	2.72	......	...		3 p. m.	W.SW	4.7	2.93	......	...
	2 p. m.	......	...	......	29.504	50		9 p. m.	West	3.7	2 79	28.753	28
	3 p: m.	N.NW	0.4	2.83	......	...	24	3 a. m.	W.NW	2.3	2.70	......	...
	9 p. m.	NE	0.9	2.85	29.588	38		7 a. m.	......	...	......	28.861	30
14	3 a. m.	E.NE	1.1	2.88	......	...		9 a. m.	N.NW	2.8	2.60	......	...
	7 a. m.	......	...	......	29.497	40		2 p. m.	......	...	......	28.958	35
	9 a. m.	East	0.4	2.89	......	...		3 p. m.	NW	2.4	2.65	......	...
	2 p. m.	......	...	......	29.306	40		9 p. m.	W.NW	2.7	2.74	29.045	35
	3 p. m.	NE	0.4	2.80	......	...	25	3 a. m.	W.NW	3.9	2.83	......	...
	9 p. m.	North	0.2	2.74	29.258	39		7 a. m.	......	...	......	29.086	33
15	3 u. m.	NW	0.1	2.65	......	...		9 a. m.	N.NW	2.1	2.76	......	...
	7 a. m.	......	...	......	29.322	34		2 p. m.	......	...	......	29.307	37
	9 a. m.	NW	1.2	2.68	......	...		3 p. m.	N.NW	1.5	2.78	......	...
	2 p. m.	......	...	......	29.429	38		9 p. m.	N.NW	0.2	2.77	29.328	35
	3 p. m.	N NW	1.3	2.68	......	...	26	3 a. m.	......	...	2.81	......	...
	9 p. m.	Calm	0.0	2.72	29.587	30		7 a. m.	......	...	......	29.412	35
16	3 a. m.	N.NW	0.4	2.78	......	...		9 a. m.	SW	1.0	2.82	......	...
	7 a. m.	......	...	......	29.675	24		2 p. m.	......	...	......	29.367	30
	9 a. m.	NW	0.7	2.87	......	...		3 p. m.	S.SW	2.3	2.92	......	...
	2 p. m.	......	...	......	29.666	35		9 p. m.	South	2.7	2.88	29.245	37
	3 p. m.	N.NE	0.7	2.96	......	...	27	3 a. m.	W.SW	2.8	3.07	......	...
	9 p. m.	NW	0.1	2.92	29.624	30		7 a. m.	......	...	......	29.137	16
17	3 a. m.	NW	0.1	2.88	......	...		9 a. m.	W.NW	4.2	3.00	......	...
	7 a. m.	......	...	......	29.581	32		2 p. m.	......	...	......	29.246	19
	9 a. m.	N.NE	0.2	2.81	......	...		3 p. m.	West	2.7	3.02	......	...
	2 p. m.	......	...	......	29.517	39		9 p. m.	West	0.9	2.98	29.367	18
	3 p. m.	Calm.	0.0	2.77	......	...	28	3 a. m.	Calm	0.0	3.12	......	...
	9 p. m.	Calm.	0.0	2.74	29.523	34		7 a. m.	......	...	......	29.318	25
18	3 a. m.	N. NW	0.1	2.74	......	...		9 a. m.	S.SW	0.1	2.99	......	...
	7 a. m.	......	...	......	29.572	33		2 p. m.	......	...	......	29.118	35
	9 a. m.	E.NE	1.2	2.78	......	...		3 p. m.	S.SE.	2.2	2.91	......	...
	2 p. m.	......	...	......	29.606	40		9 p. m.	W.SW	2.2	2.99	28.958	37
	3 p. m.	E.NE	1.3	2.80	......	...	29	3 a. m.	W.NW	3.6	2.96	......	...
	9 p. m.	E.SE	1.6	2.77	29.581	40		7 a. m.	......	...	......	......	20
19	3 a. m.	SE	3.6	2.77	......	...		9 a. m.	W.NW	3.3	2.89	......	...
	7 a. m.	......	...	......	29.470	41		2 p. m.	......	...	......	29.304	24
	9 a. m.	SE.	4.9	2.78	......	...		3 p. m.	W.NW	1.9	3.00	......	...
	2 p. m.	......	...	......	29.209	43		9 p. m.	W.NW	2.9	3.13	29.346	15
	3 p. m.	SE.	5.5	2.53	......	...	30	3 a. m.	W.NW	3.3	3.14	......	...
	9 p. m.	S.SE	4.4	2.65	29.043	43		7 a. m.	......	...	......	29.411	04
20	3 a. m.	South	2.9	2.58	......	...		9 a. m.	West	1.1	......	......	...
	7 a. m.	......	...	......	28.963	43		2 p. m.	......	...	......	29.372	14
	9 a. m.	SW	3.6	2.68	......	...		3 p. m.	West	0.2	......	......	...
	2 p. m.	......	...	......	29.126	43		9 p. m.	Calm	0.0	......	29.315	13

Table AA.—*Showing the wind, water, barometer, &c.*—**Continued.**

Date.	Hour of day.	Wind.		Heig't of water above zero of tide-gauge.	Barometer reduced to 32°.	Therm'r detached.
		Course.	Relative velocity.			
1861. Dec. 1	3 a. m.	NW	0.6			
	7 a. m.				29.306	5
	9 a. m.	W.NW	2.2			
	2 p. m.				29.330	12
	3 p. m.	West	2.5			
	9 p. m.	NW	2.3		29.472	2
2	3 a. m.	NW	0.3			
	7 a. m.				29.529	4
	9 a. m.	West	0.7			
	2 p. m.				29.495	9
	3 p. m.	NW	1.0			
	9 p. m.	Calm	0.0		29.555	2
3	3 a. m.	Calm	0.0			
	7 a. m.				29.564	0
	9 a. m.	West	0.5			
	2 p. m.				29.507	23
	3 p. m.	SW	1.6			
	9 p. m.	SW	1.7		29.440	20
4	3 a. m.	SW	2.0			
	7 a. m.				29.283	21
	9 a. m.	SW	2.4			
	2 p. m.				29.210	38
	3 p. m.	SW	2.1			
	9 p. m.	Calm	0.0		29.300	30
5	3 a. m.	Calm	0.0			
	7 a. m.				29.422	27
	9 a. m.	Calm	0.0			
	2 p. m.				29.427	39
	3 p. m.	Calm	0.0			
	9 p. m.	Calm	0.0		29.412	40
6	3 a. m.	SW	2.8			
	7 a. m.				29.464	47
	9 a. m.	SW	2.9			
	2 p. m.				29.406	55
	3 p. m.	SW	2.5			
	9 p. m.	SW	2.6		29.426	54
7	3 a. m.	SW	3.1			
	7 a. m.				29.307	54
	9 a. m.	SW	1.3			
	2 p. m.				29.254	54
	3 p. m.	SW	0.7			
	9 p. m.	W. SW.	0.5		29.304	52
8	3 a. m.	W. SW.	0.8			
	7 a. m.				29.340	44
	9 a. m.	W.NW.	0.6			
	2 p. m.				29.309	44
	3 p. m.	SW	0.6			
	9 p. m.	SW	0.1		29.299	41
9	3 a. m.	SW	0.1			
	7 a. m.				29.151	48
	9 a. m.	SW	1.4			
	2 p. m.				29.030	57
	3 p. m.	SW	1.1			
	9 p. m.	SW	0.6		29.050	52
10	3 a. m.	SW	0.8			
	7 a. m.				28.953	55
	9 a. m.	SW	0.3			
	2 p. m.				29.075	47
	3 p. m.	NW	5.1			
	9 p. m.	W. NW.	3.7		29.523	31
11	3 a. m.	NW	2.2			
	7 a. m.				29.897	18
	9 a. m.	NW	1.3			
	2 p. m.				29,895	29
	3 p. m.	West	0.7			
	9 p. m.	West	0.7		29.879	26
12	3 a. m.	W.SW.	0.5			
	7 a. m.				29.892	27
	9 a. m.	W.SW.	2.1			
	2 p. m.				29.815	40
	3 p. m.	SW	2.8			
	9 p. m.	SW	2.0		29.789	33
1861. Dec. 13	3 a. m.	W.SW.	1.4			
	7 a. m.				29.734	31
	9 a. m.					
	2 p. m.				29.644	45
	3 p. m.	SW	0.8			
	9 p. m.	W.SW.	2.1		29.583	39
14	3 a. m.	SW	1.1			
	7 a. m.				29.487	35
	9 a. m.	W.SW.	1.6			
	2 p. m.				29.648	42
	3 p. m.	N. NE.	3.5			
	9 p. m.	N. NE.	0.9		29.534	34
15	3 a. m.	NE	1.7			
	7 a. m.				29.879	35
	9 a. m.	SE	2.0			
	2 p. m.				29.780	43
	3 p. m.	S. SW.	1.1			
	9 p. m.	SW	1.7		29.679	36
16	3 a. m.	W. SW.	3.7			
	7 a. m.				29.495	40
	9 a. m.	SW	4.6			
	2 p. m.				29.454	48
	3 p. m.	W.SW.	2.1			
	9 p. m.	East	0.4		29.551	34
17	3 a. m.	SE	0.2			
	7 a. m.				29.492	33
	9 a. m.	West	1.2			
	2 p. m.				29.291	53
	3 p. m.	SW	2.2			
	9 p. m.	SW	2.3		29.381	42
18	3 a. m.	E. NE.	0.3			
	7 a. m.				29.587	32
	9 a. m.	SE	0.5			
	2 p. m.				29.554	41
	3 p. m.	SW	1.0			
	9 p. m.	W	1.0		29.431	38
19	3 a. m.	NW	0.5			
	7 a. m.				29.282	41
	9 a. m.	N. NW.	1.8			
	2 p. m.				29.329	45
	3 p. m.	N. NW.	1.6			
	9 p. m.	NE	2.8		59.504	36
20	3 a. m.	NE	3.7			
	7 a. m.				29.771	13
	9 a. m.	NE	2.9			
	2 p. m.				29.743	13
	3 p. m.	N. NE.	2.3			
	9 p. m.	NE	0.9		29.939	8
21	3 a. m.	Calm	0.0			
	7 a. m.				29.958	4
	9 a. m.	NW	0.4			
	2 p. m.				29.870	19
	3 p. m.	W.NW.	0.3			
	9 p. m.	Calm	0.0		29.784	16
22	3 a. m.	NE	0.5			
	7 a. m.				29.584	28
	9 a. m.	S.SE	2.4			
	2 p. m.				29.362	27
	3 p. m.	SE	3.4			
	9 p. m.	E. SE	5.2		29.229	28
23	3 a. m.	E. NE.	4.1			
	7 a. m.				29.413	22
	9 a. m.	NE	2.9			
	2 p. m.				29.461	27
	3 p. m.	NE	0.8			
	9 p. m.	N. NW.	0.1		29.628	23
24	3 a. m.	Calm	0.0			
	7 a. m.				29.433	23
	9 a. m.	W. SW.	0.8			
	2 p. m.				29.306	29
	3 p. m.	SW	2.1			
	9 p. m.	West	0.9		29.316	29

TABLE AA.—*Showing the wind, water, barometer, &c.*—Continued.

Date.	Hour of day.	Wind.		Heig't of water above zero of tide-gauge.	Barometer reduced to 32°.	Therm'r detached.	Date.	Hour of day.	Wind.		Heig't of water above zero of tide-gauge.	Barometer reduced to 32°.	Therm'r detached.
		Course.	Relative velocity.						Course.	Relative velocity.			
1861. 25	3 a. m.	N. NW.	0.1				1862. Jan. 6	3 a. m.	NE	0.4			
	7 a. m.				29.363	27		7 a. m.				29.241	18
	9 a. m.	E. NE	0.1					9 a. m.	North	0.7			
	2 p. m.				29.319	33		2 p. m.				29.331	23
	3 p. m.	South	1.4					3 p. m.	N. NW	1.6			
	9 p. m.	SW	3.0		29.226	36		9 p. m.	N. NW	0.3		29.541	21
26	3 a. m.	W. SW	2.3				7	3 a. m.	Calm	0.0			
	7 a. m.				28.939	38		7 a. m.				29.707	6
	9 a. m.	W. NW.	2.2					9 a. m.	Calm	0.0			
	2 p. m.				29.003	29		2 p. m.				29.685	21
	3 p. m.	SW	5 9					3 p. m.	West	0.3			
	9 p. m.	W. SW	7.1		29.372	19		9 p. m.	W. SW	0.3		29.614	20
27	3 a. m.	W. SW	4.0				8	3 a. m.	W. SW	1.7			
	7 a. m.				29.862	10		7 a. m.				29.263	27
	9 a. m.	SW	1.0					9 a. m.	W. NW.	1.0			
	2 p. m.				29.940	19		2 p. m.				29.222	37
	3 p. m.	S. SE	0.1					3 p. m.	NW	0.7			
	9 p. m.	S. SE	0.5		29.899	19		9 p. m.	Calm	0.0		29.329	36
28	3 a. m.	S. SE	1.3				9	3 a. m.	N. NW	0.1			
	7 a. m.				29.725	21		7 a. m.				29.393	33
	9 a. m.	SE	2.2					9 a. m.	W. NW.	0.5			
	2 p. m.				29.500	29		2 p. m.				29.344	34
	3 p. m.	SE	1.5					3 p. m.	NW	0.2			
	9 p. m.	S. SE	0.5		29.437	30		9 p. m.	W. SW.	0.1		29.339	32
29	3 a. m.	West	0.3				10	3 a. m.	North	1.9			
	7 a. m.				29.516	22		7 a. m.				29.192	22
	9 a. m.	West	0.5					9 a. m.	North	4.1			
	2 p. m.				29.636	31		2 p. m.				29.459	10
	3 p. m.	W. NW.	0.2					3 p. m.	West	2.3			
	9 p. m.	Calm	0.0		29.724	21		9 p. m.	NW	0.7		29.583	6
30	3 a. m.	Calm	0.0				11	3 a. m.	N. NW	0.1			
	7 a. m.				29.704	16		7 a. m.				29.347	13
	9 a. m.	South	0.9					9 a. m.	Calm	0.0			
	2 p. m.				29.609	37		2 p. m.				29.028	26
	3 p. m.	S. SE	1.1					3 p. m.	S. SW	0.7			
	9 p. m.	S. SE	0.4		29.472	29		9 p. m.	W. SW	1.1		29.028	19
31	3 a. m.	South	0.7				12	3 a. m.	NW	1.1			
	7 a. m.				29.231	31		7 a. m.				29.050	11
	9 a. m.	S. SW	1.1					9 a. m.	NW	1.9			
	2 p. m.				29.041	41		2 p. m.				29.309	8
	3 p. m.	S. SW	0.8					3 p. m.	W. NW.	4.0			
	9 p. m.	SW	1.0		28.935	40		9 p. m.	West	2.2		29.652	—1
1862. Jan. 1	3 a. m.	SW	4.3				13	3 a. m.	W. NW.	2.4			
	7 a. m.				29.098	26		7 a. m.				29.972	—17
	9 a. m.	W. SW	6.6					9 a. m.	W. SW	0.9			
	2 p. m.				29.426	20		2 p. m.				29.989	—19
	3 p. m.	West						3 p. m.	W. SW	0.6			
	9 p. m.	West	0.5		29.684	15		9 p. m.	W. SW	0.1		30.011	—12
2	3 a. m.	W. NW.	1.0				14	3 a. m.	Calm	0.0			
	7 a. m.				29.762	14		7 a. m.				29.934	—15
	9 a. m.	N. NW	1.3					9 a. m.	Calm	0.0			
	2 p. m.				29.718	27		2 p. m.				29.721	13
	3 p. m.	SE	2.1					3 p. m.	E. SE	1.2			
	9 p. m.	S. SE	2.3		29.701	26		9 p. m.	E. SE	3 0		29.423	22
3	3 a. m.	S. SE	2.1				15	3 a. m.	South	0.1			
	7 a. m.				29.567	24		7 a. m.				29.102	19
	9 a. m.	South	2.7					9 a. m.	W. SW	2.1			
	2 p. m.				29.401	24		2 p. m.				29.173	17
	3 p. m.	S. SE	2.8					3 p. m.	West	3.4			
	9 p. m.	S. SE	1.9		29.431	25		9 p. m.	W. NW.	1.8		29.487	17
4	3 a. m.	SE	1.4				16	3 a. m.	Calm	0.0			
	7 a. m.				29.487	23		7 a. m.				29.798	—5
	9 a. m.	SE	1.5					9 a. m.	West	0.7			
	2 p. m.				29.497	26		2 p. m.				29.853	8
	3 p. m.	SE	0.1					3 p. m.	Calm	0.0			
	9 p. m.	South	0.6		29.486	24		9 p. m.	Calm	0.0		29.833	5
5	3 a. m.	S. SW	1.3				17	3 a. m.	Calm	0.0			
	7 a. m.				29.376	24		7 a. m.				29.643	10
	9 a. m.	South	1.5					9 a. m.	Calm	0.0			
	2 p. m.				29.212	26		2 p. m.				29.634	24
	3 p. m.	SE	1.5					3 p. m.	N. NW	0.1			
	9 p. m.	Calm	0.0		29.134	26		9 p. m.	South	0.6		29.652	29

TABLES AA.—*Showing the wind, water, barometer, &c.*—Continued.

Date.	Hour of day.	WIND.		Heig't of water above zero of tide gauge.	Barometer reduced to 32°.	Therm'r detached.	Date.	Hour of day.	WIND.		Heig't of water above zero of tide gauge.	Barometer reduced to 32°.	Therm'r detached.
		Course.	Relative velocity.						Course.	Relative velocity.			
1862. Jan. 18	3 a. m.	Calm	0.0				1862. Jan. 30	3 a. m.	W.NW	0.7			
	7 a. m.				29.411	17		7 a. m.					
	9 a. m.	Calm	0.0					9 a. m.	NW	0.3			
	2 p. m.				29.364	26		2 p. m.					
	3 p. m.	E. SE	0.2					3 p. m.	NW	0.2			
	9 p. m.	NW	0.3		29.273	24		9 p. m.	Calm	0.0			
19	3 a. m.	N. NW	0.7				31	3 a. m.	Calm	0.0			
	7 a. m.				29.198	31		7 a. m.					
	9 a. m.	NE	1.1					9 a. m.	South	1.0			
	2 p. m.				29.212	34		2 p. m.					
	3 p. m.	N. NE	1.7					3 p. m.	S. SW	1.2			
	9 p. m.	NE	2.4		29.201	32		9 p. m.	West	2.2			
20	3 a. m.	N. NE	2.7				Feb. 1	3 a. m.	West	1.7		29.531	3
	7 a. m.				29.300	32		7 a. m.					
	9 a. m.	N. NE	3.8					9 a. m.	West	2.1		29.623	8
	2 p. m.				29.376	34		2 p. m.					
	3 p. m.	N. NE	4.3					3 p. m.	West	2.1		29.792	0
	9 p. m.	N. NE	2.5		29.482	32		9 p. m.	West	0.4			
21	3 a. m.	East	0.1				2	3 a. m.	Calm	0.0		29.873	9
	7 a. m.				29.469	19		7 a. m.					
	9 a. m.	Calm	0.0					9 a. m.	Calm	0.0		29.805	11
	2 p. m.				29.409	32		2 p. m.					
	3 p. m.	E. NE	0.2					3 p. m.	Calm	0.0		29.707	10
	9 p. m.	Calm	0.0					9 p. m.	Calm	0.0			
22	3 a. m.	Calm	0.0				3	3 a. m.	E. SE	1.2		29.427	26
	7 a. m.							7 a. m.					
	9 a. m.	SW	0.7					9 a. m.	SE	0.9		29.477	25
	2 p. m.							2 p. m.					
	3 p. m.	W. SW	0.2					3 p. m.	West	2.3		29.501	12
	9 p. m.	W. SW	0.4					9 p. m.	W. NW	1.4			
23	3 a. m.	W. SW	0.1				4	3 a. m.	West	0.9		29.640	4
	7 a. m.							7 a. m.					
	9 a. m.	S. SE	0.2					9 a. m.	Calm	0.0		29.642	23
	2 p. m.							2 p. m.					
	3 p. m.	S. SE	0.4					3 p. m.	S.SW	0.2		29.611	12
	9 p. m.	S. SE	1.3					9 p. m.	Calm	0.0			
24	3 a. m.	S. SE	0.4				5	3 a. m.	Calm	0.0		29.472	17
	7 a. m.							7 a. m.					
	9 a. m.	S. SE	1.4					9 a. m.	S.SW	0.4		29.324	33
	2 p. m.							2 p. m.					
	3 p. m.	S. SE	0.4					3 p. m.	South	0.5		29.236	32
	9 p. m.	W. NW	1.3					9 p. m.	S. SE	0.3			
25	3 a. m.	West	0.9				6	3 a. m.	W.SW	0.9		29.027	28
	7 a. m.							7 a. m.					
	9 a. m.	W.NW	3.4					9 a. m.	W.NW	3.8		29.219	30
	2 p. m.							2 p. m.					
	3 p. m.	West	4.0					3 p. m.	W.NW	3.9		29.446	19
	9 p. m.	West	3.1					9 p. m.	W.NW	2.4			
26	3 a. m.	West	2.4				7	3 a. m.	NW	1.4		29.587	11
	7 a. m.							7 a. m.					
	9 a. m.	West	1.9					9 a. m.	N.NW	1.5		29.616	22
	2 p. m.							2 p. m.					
	3 p. m.	SW	0.5					3 p. m.	N.NW	0.6		29.621	15
	9 p. m.	Calm	0.0					9 p. m.	W.NW	1.2			
27	3 a. m.	E. SE	0.6				8	3 a. m.	W.NW	0.3		29.551	10
	7 a. m.							7 a. m.					
	9 a. m.	E.SE	4.1					9 a. m.	W.NW	0.7		29.502	17
	2 p. m.							2 p. m.					
	3 p. m.	E.SE	4.3					3 p. m.	West	2.2		29.518	7
	9 p. m.	SE	2.7					9 p. m.	West	1.1			
28	3 a. m.	E.SE	0.9				9	3 a. m.	West	0.2		29.602	—4
	7 a. m.							7 a. m.					
	9 a. m.	Calm	0.0					9 a. m.	West	0.3		29.576	15
	2 p. m.							2 p. m.					
	3 p. m.	Calm	0.0					3 p. m.	W.SW	0.6		29.474	13
	9 p. m.	W.NW	1.0					9 p. m.	SW	0.5			
29	3 a. m.	West	3.4				10	3 a. m.	S. SW	0.5		29.260	17
	7 a. m.							7 a. m.					
	9 a. m.	Calm	0.0					9 a. m.	S. SW	1.0		29.058	31
	2 p. m.							2 p. m.					
	3 p. m.	West	2.6					3 p. m.	S. SW	1.9		28.865	30
	9 p. m.	W.NW	1.5					9 p. m.	S. SW	1.2			

TABLES AA.—*Showing the wind, water, barometer, &c.*—Continued.

Date.	Hour of day.	WIND.		Heig't of water above zero of tide-gauge.	Barometer reduced to 32°.	Therm'r detached.	Date.	Hour of day.	WIND.		Heig't of water above zero of tide-gauge.	Barometer reduced to 32°.	Therm'r detached.
		Course.	Relative velocity.						Course.	Relative velocity.			
1862. Feb. 11	3 a. m.	S. SE...	0.3	......	28.642	29	1862. Feb. 23	3 a. m.	Calm...	0.0	......	....	....
	7 a. m.	....	...	......	....	....		7 a. m.	....	...	......	28.916	36
	9 a. m.	NW....	3.3	......	....	....		9 a. m.	W. SW.	0.3	......	....	....
	2 p. m.	....	...	......	28.612	29		2 p. m.	....	...	......	28.918	41
	3 p. m.	W.NW.	3.3	......	....	....		3 p. m.	Calm...	0.0	......	....	....
	9 p. m.	W. SW.	0.2	......	28.867	25		9 p. m.	N. NE..	3.5	......	29.043	33
12	3 a. m.	Calm...	0.0	......	....	....	24	3 a. m.	N. NW.	2.3	......	....	....
	7 a. m.	....	...	......	29.101	17		7 a. m.	....	...	......	29.492	16
	9 a. m.	W.NW..	0.2	......	....	....		9 a. m.	N. NW.	0.5	......	....	....
	2 p. m.	....	...	......	29.211	33		2 p. m.	....	...	......	29.642	25
	3 p. m.	NE.....	1.2	......	....	....		3 p. m.	W.NW.	0.4	......	....	....
	9 p. m.	E. NE..	0.7	......	29.304	29		9 p. m.	Calm...	0.0	......	29.717	16
13	3 a. m.	E. NE..	0.2	......	....	....	25	3 a. m.	S. SE...	0.4	......	....	....
	7 a. m.	....	...	......	29.291	27		7 a. m.	....	...	......	29.715	15
	9 a. m.	West...	2.3	......	....	....		9 a. m.	S. SE...	2.4	......	....	....
	2 p. m.	....	...	......	29.327	20		2 p. m.	....	...	......	29.384	33
	3 p. m.	W.NW.	4.7	......	....	....		3 p. m.	S. SE...	3.1	......	....	....
	9 p. m.	W.NW.	4.3	......	29.490	2		9 p. m.	S. SE...	0.7	......	29.191	31
14	3 a. m.	W.NW.	0.8	......	....	....	26	3 a. m.	Calm...	0.0	......	....	....
	7 a. m.	....	...	......	29.624	-13		7 a. m.	....	...	......	29.013	26
	9 a. m.	West...	0.9	......	....	....		9 a. m.	W. NW.	2.0	......	....	....
	2 p. m.	....	...	......	29.631	—3		2 p. m.	....	...	......	29.113	39
	3 p. m.	W. SW.	1.4	......	....	....		3 p. m.	W.NW.	4.8	......	....	....
	9 p. m.	W.SW.	0.4	......	29.568	—8		9 p. m.	N. NW.	3.0	......	29.344	23
15	3 a. m.	SW....	0.6	......	....	....	27	3 a. m.	NW....	2.5	......	....	....
	7 a. m.	....	...	......	29.321	—3		7 a. m.	....	...	......	29.455	9
	9 a. m.	W. SW.	2.1	......	....	....		9 a. m.	NW....	1.9	......	....	....
	2 p. m.	....	...	......	29.320	2		2 p. m.	....	...	......	29.487	23
	3 p. m.	W. SW.	2.6	......	....	....		3 p. m.	W. SW.	1.4	......	....	....
	9 p. m.	Calm...	0.0	......	29.468	—3		9 p. m.	West...	0.7	......	29.492	17
16	3 a. m.	Calm...	0.0	......	....	....	28	3 a. m.	N. NW.	0.5	......	....	....
	7 a. m.	....	...	......	29.550	—1		7 a. m.	....	...	......	29.613	13
	9 a. m.	S. SE...	0.3	......	....	....		9 a. m.	N. NW.	1.2	......	....	....
	2 p. m.	....	...	......	29.472	30		2 p. m.	....	...	......	29.605	17
	3 p. m.	S. SE...	0.8	......	....	....		3 p. m.	N. NE..	1.6	......	....	....
	9 p. m.	S. SE...	0.2	......	29.452	26		9 p. m.	North..	0.4	......	29.589	15
17	3 a. m.	Calm...	0.0	......	....	....	March 1	3 a. m.	N. NE..	1.5	......	....	....
	7 a. m.	....	...	......	29.392	10		7 a. m.	....	...	......	29.522	17
	9 a. m.	S. SE...	0.8	......	....	....		9 a. m.	NE.....	1.5	......	....	....
	2 p. m.	....	...	......	....	32		2 p. m.	....	...	......	29.404	28
	3 p. m.	S. SE...	0.6	......	....	....		3 p. m.	N. NE..	2.5	......	....	....
	9 p. m.	W. SW.	5.9	......	29.217	30		9 p. m.	E. NE..	1.1	......	29.354	29
18	3 a. m.	West...	2.6	......	....	....	2	3 a. m.	NE.....	3.7	......	....	....
	7 a. m.	....	...	......	29.574	0		7 a. m.	....	...	......	29.267	25
	9 a. m.	West...	1.5	......	....	....		9 a. m.	E. NE..	4.2	......	....	....
	2 p. m.	....	...	......	29.651	15		2 p. m.	....	...	......	29.130	28
	3 p. m.	W. SW.	1.3	......	....	....		3 p. m.	NE.....	3.9	......	....	....
	9 p. m.	W. SW.	0.2	......	29.663	14		9 p. m.	E. NE..	2.7	......	28.938	29
19	3 a. m.	N.NW..	0.3	......	....	....	3	3 a. m.	E. SE..	2.1	......	....	....
	7 a. m.	....	...	......	29.536	14		7 a. m.	....	...	......	28.689	27
	9 a. m.	E. NE..	1.6	......	....	....		9 a. m.	S. SW..	2.9	......	....	....
	2 p. m.	....	...	......	29.351	26		2 p. m.	....	...	......	28.655	28
	3 p. m.	N. NE..	4.8	......	....	....		3 p. m.	S. SW..	2.3	......	....	....
	9 p. m.	N. NW.	3.9	......	29.336	25		9 p. m.	W. SW.	2.3	......	28.695	22
20	3 a. m.	N. NW.	0.6	......	....	....	4	3 a. m.	W. SW.	2.8	......	....	....
	7 a. m.	....	...	......	29.601	12		7 a. m.	....	...	......	28.721	14
	9 a. m.	West...	0.4	......	....	....		9 a. m.	W. SW.	2.8	......	....	....
	2 p. m.	....	...	......	29.667	24		2 p. m.	....	...	......	28.788	22
	3 p. m.	West...	0.7	......	....	....		3 p. m.	W. SW.	2.3	......	....	....
	9 p. m.	Calm...	0.0	......	29.697	18		9 p. m.	SW....	1.3	......	28.886	17
21	3 a. m.	Calm...	0.0	......	....	....	5	3 a. m.	W. SW.	0.2	......	....	....
	7 a. m.	....	...	......	29.467	22		7 a. m.	....	...	......	28.937	9
	9 a. m.	SW....	1.0	......	....	....		9 a. m.	S.SW..	0.1	......	....	....
	2 p. m.	....	...	......	29.320	31		2 p. m.	....	...	......	29.013	25
	3 p. m.	W. SW.	0.6	......	....	....		3 p. m.	Calm...	0.0	......	....	....
	9 p. m.	....	...	......	29.286	29		9 p. m.	Calm...	0.0	......	29.202	16
22	3 a. m.	Calm...	0.0	......	....	....	6	3 a. m.	Calm...	0.0	......	....	....
	7 a. m.	....	...	......	29.116	30		7 a. m.	....	...	......	29.099	17
	9 a. m.	Calm...	0.0	......	....	....		9 a. m.	W.SW.	1.1	......	....	....
	2 p. m.	....	...	......	28.978	38		2 p. m.	....	...	......	29.113	34
	3 p. m.	Calm...	0.0	......	....	....		3 p. m.	West...	0.3	......	....	....
	9 p. m.	Calm...	0 0	......	28.988	35		9 p. m.	Calm...	0.0	......	29.226	35

TABLE AA.—*Showing the wind, water, barometer, &c.*—Continued.

Date.	Hour of day.	WIND.		Heig't of water above zero of tide-gauge.	Barometer reduced to 32°.	Therm'r detached.
		Course.	Relative velocity.			
1862. Mar. 7	3 a. m.	Calm	0.0			
	7 a. m.				29.347	32
	9 a. m.	Calm	0.0			
	2 p. m.				29.316	42
	3 p. m.	Calm	0.0			
	9 p. m.	Calm	0.0		29.314	32
8	3 a. m.	Calm	0.0			
	7 a. m.				29.287	32
	9 a. m.	S.SW				
	2 p. m.				29.254	42
	3 p. m.	S.SE	0.9			
	9 p. m.	SE	1.5		29.266	43
9	3 a. m.	E.SE	1.0			
	7 a. m.				29.021	36
	9 a. m.	SE	1.8			
	2 p. m.				28.918	47
	3 p. m.	S.SW	2.4			
	9 p. m.	W.SW	1.0		29.000	40
10	3 a. m.	West	0.8			
	7 a. m.				29.139	35
	9 a. m.	West	2.9			
	2 p. m.				29.281	35
	3 p. m.	W.SW	3.0			
	9 p. m.	W.SW	0.9		29.431	30
11	3 a. m.	W.SW	0.4			
	7 a. m.				29.423	26
	9 a. m.	W.SW	1.1			
	2 p. m.				29.402	35
	3 p. m.	W.SW	3.2			
	9 p. m.	W.SW	1.9		29.404	31
12	3 a. m.	NW	1.9			
	7 a. m.				29.448	24
	9 a. m.	N.NW	2.0			
	2 p. m.				29.459	28
	3 p. m.	NE	3.2			
	9 p. m.	NE	3.6		29.388	29
13	3 a. m.	E.NE	4.2			
	7 a. m.				29.270	32
	9 a. m.	NE	4.1			
	2 p. m.				29.276	34
	3 p. m.	N.NE	4.3			
	9 p. m.	N.NE	4.9		29.316	33
14	3 a. m.	N.NE	6.0			
	7 a. m.				29.348	31
	9 a. m.	N.NE	6.0			
	2 p. m.				29.279	31
	3 p. m.	N.NE	5.2			
	9 p. m.	N.NE	4.9		29.228	31
15	3 a. m.	N.NE	4.6			
	7 a. m.				29.126	32
	9 a. m.	N.NE	6.0			
	2 p. m.				29.061	33
	3 p. m.	N.NE	6.8			
	9 p. m.	N.NE	5.7		29.088	34
16	3 a. m.	N.NE	2.6			
	7 a. m.	N.NE	2.6		29.124	30
	9 a. m.	N.NE	2.3			
	2 p. m.				29.108	35
	3 p. m.	N.NE	2.2			
	9 p. m.	N.NW	0.2		29.181	30
17	3 a. m.	N.NW	-0.2			
	7 a. m.				29.229	30
	9 a. m.	N.NE	0.8			
	2 p. m.				29.264	38
	3 p. m.	E.SE	0.3			
	9 p. m.	Calm	0.0		29.316	32
18	3 a. m.	East	0.1			
	7 a. m.				29.397	35
	9 a. m.	E.NE	1.2			
	2 p. m.				29.479	38
	3 p. m.	E.NE	1.0			
	9 p. m.	NE	0.6		29.484	34
1862. Mar. 19	3 a. m.	E.NE	0.9			
	7 a. m.				29.361	33
	9 a. m.	E.NE	2.7			
	2 p. m.				29.247	35
	3 p. m.	E.NE	3.3			
	9 p. m.	E.NE	4.4		29.171	32
20	3 a. m.	E.NE	1.8			
	7 a. m.				29.121	35
	9 a. m.	N.NE	2.9			
	2 p. m.				29.003	35
	3 p. m.	N.NE	6.6			
	9 p. m.	N.NE	7.3		29.008	36
21	3 a. m.	N.NE	7.5			
	7 a. m.				29.012	34
	9 a. m.	N.NE	9.4			
	2 p. m.				29.101	35
	3 p. m.	N.NE	7.0			
	9 p. m.	N.NE	3.4		29.181	34
22	3 a. m.	N.NW	0.6			
	7 a. m.				29.109	32
	9 a. m.	N.NW	0.5			
	2 p. m.				29.071	38
	3 p. m.	N.NE	0.2			
	9 p. m.	NW	0.2		29.121	32
23	3 a. m.	North	0.7			
	7 a. m.				29.181	32
	9 a. m.	N.NE	2.0			
	2 p. m.				29.214	34
	3 p. m.	N.NE	3.8			
	9 p. m.	N.NE	3.6		29.296	31
24	3 a. m.	North	0.2			
	7 a. m.				29.312	23
	9 a. m.	N.NW	0.6			
	2 p. m.				29.294	32
	3 p. m.	NE	0.4			
	9 p. m.	Calm	0.0		29.326	29
25	3 a. m.	Calm	0.0			
	7 a. m.				29.343	23
	9 a. m.	Calm	0.0			
	2 p. m.				29.307	36
	3 p. m.	SE	0.4			
	9 p. m.	Calm	0.0		29.291	34
26	3 a. m.	Calm	0.0			
	7 a. m.				29.330	35
	9 a. m.	N.NE	1.0			
	2 p. m.				29.434	40
	3 p. m.	N.NE	0.5			
	9 p. m.	Calm	0.0		29.526	35
27	3 a. m.	Calm	0.0			
	7 a. m.				29.590	36
	9 a. m.	N.NE	0.1			
	2 p. m.				29.476	43
	3 p. m.	S.SE	0.1			
	9 p. m.	Calm	0.0		29.531	36
28	3 a. m.	Calm	0.0			
	7 a. m.				29.454	36
	9 a. m.	Calm	0.0			
	2 p. m.				29.342	40
	3 p. m.	Calm	0.0			
	9 p. m.				29.266	40
29	3 a. m.	*				
	7 a. m.				29,139	36
	9 a. m.					
	2 p. m.				29.088	39
	3 p. m.					
	9 p. m.				29.085	37
30	3 a. m.					
	7 a. m.				29.936	39
	9 a. m.					
	2 p. m.				29.016	44
	3 p. m.					
	9 p. m.				29.284	39

* Anemograph out of order from the 29th of March until the 15th of April.

TABLE AA.—*Showing the wind, water, barometer, &c.*—Continued.

Date.	Hour of day.	WIND.		Heig't of water above zero of tide-gauge.	Barometer reduced to 32°.	Therm'r detached.
		Course.	Relative velocity.			
1862.						
Mar. 31	3 a. m.					
	7 a. m.				29.561	35
	9 a. m.					
	2 p. m.				29.633	43
	3 p. m.					
	9 p. m.				29.622	38
April 1	3 a. m.			3.43		
	7 a. m.				29.573	38
	9 a. m.			3.48		
	2 p. m.				29.444	41
	3 p. m.			3.24		
	9 p. m.			3.15	29.324	42
2	3 a. m.			3.05		
	7 a. m.				28.942	38
	9 a. m.			3.08		
	2 p. m.				28.738	47
	3 p. m.			3.17		
	9 p. m.			3.25	29.264	40
3	3 a. m.			3.26		
	7 a. m.				29.553	34
	9 a. m.			3.40		
	2 p. m.				29.564	43
	3 p. m.			3.31		
	9 p. m.			3.26	29.544	47
4	3 a. m.			3.07		
	7 a. m.				29.425	36
	9 a. m.			3.03		
	2 p. m.				29.182	39
	3 p. m.			2.88		
	9 p. m.			2.97	28.946	38
5	3 a. m.			2.92		
	7 a. m.					35
	9 a. m.			3.15		
	2 p. m.				29.326	43
	3 p. m.			3.26		
	9 p. m.			3.29	29.462	36
6	3 a. m.			3.31		
	7 a. m.				29.702	24
	9 a. m.			3.42		
	2 p. m.				29.685	33
	3 p. m.			3.44		
	9 p. m.			3.35	29.627	30
7	3 a. m.			3.21		
	7 a. m.				29.483	34
	9 a. m.			3.05		
	2 p. m.				29.394	34
	3 p. m.			2.83		
	9 p. m.			2.65	29.274	31
8	3 a. m.			2.60		
	7 a. m.				29.158	32
	9 a. m.			2.55		
	2 p. m.				29.131	33
	3 p. m.			2.58		
	9 p. m.			2.41	29.186	33
9	3 a. m.			2.50		
	7 a. m.				29.182	32
	9 a. m.			2.41		
	2 p. m.				29.214	35
	3 p. m.			2.57		
	9 p. m.			2.68	29.379	33
10	3 a. m.			2.88		
	7 a. m.				29.557	35
	9 a. m.			2.88		
	2 p. m.				29.626	40
	3 p. m.			2.96		
	9 p. m.			2.93	29.639	35
11	3 a. m.			2.94		
	7 a. m.				29.701	36
	9 a. m.			2.91		
	2 p. m.				29.629	46
	3 p. m.			2.93		
	9 p. m.			2.75	29.579	42
1862.						
April 12	3 a. m.			2.78		
	7 a. m.				29.413	41
	9 a. m.			2.73		
	2 p. m.				29.320	40
	3 p. m.			2.75		
	9 p. m.			2.65	29.254	41
13	3 a. m.			2.67		
	7 a. m.				29.171	45
	9 a. m.			2.82		
	2 p. m.				29.206	49
	3 p. m.			2.85		
	9 p. m.			2.90	29.263	44
14	3 a. m.			3.00		
	7 a. m.				29.317	44
	9 a. m.			3.06		
	2 p. m.				29.332	54
	3 p. m.	E.SE	1.6	3.02		
	9 p. m.	Calm	0.0	3.00	29.382	45
15	3 a. m.	E.SE	2.4	2.96		
	7 a. m.				29.235	45
	9 a. m.	E.SE	1.2	3.04		
	2 p. m.				29.193	56
	3 p. m.	E.SE	1.9	2.86		
	9 p. m.	SE	1.5	2.88	29.121	54
16	3 a. m.	S	2.6	2.89		
	7 a. m.				29.143	59
	9 a. m.	SW	0.9	2.86		
	2 p. m.				29.065	57
	3 p. m.	W.SW	1.9	2.95		
	9 p. m.	W.SW	0.7	3.01	29.308	55
17	3 a. m.	Calm	0.0	3.03		
	7 a. m.				29.622	43
	9 a. m.	W.NW	0.2	3.07		
	2 p. m.				29.530	48
	3 p. m.	S.SE	0.3	3.05		
	9 p. m.	E.NE	0.1	3.06	29.449	44
18	3 a. m.	Calm	0.0	2.92		
	7 a. m.				29.332	45
	9 a. m.	W	0.4	3.06		
	2 p. m.				29.452	51
	3 p. m.	W.NW	2.2	2.85		
	9 p. m.	N.NW	0.2	2.93	29.582	47
19	3 a. m.	N.NE	0.6	3.05		
	7 a. m.				29.652	42
	9 a. m.	NE	0.4	3.09		
	2 p. m.				29.672	41
	3 p. m.	NE	1.1	3.01		
	9 p. m.	N.NE	0.5	2.97	29.641	36
20	3 a. m.	N.NE	1.5	2.87		
	7 a. m.				29.600	35
	9 a. m.	N.NE	3.3	2.87		
	2 p. m.				29.500	40
	3 p. m.	N.NE	4.2	2.79		
	9 p. m.	N.NE	3.6	2.73	29.364	37
21	3 a. m.	N.NE	3.1	2.69		
	7 a. m.				29.180	48
	9 a. m.	N.NE	4.1	2.67		
	2 p. m.				29.153	41
	3 p. m.	N.NE	4.1	2.64		
	9 p. m.	N.NE	1.6	2.65	29.133	41
22	3 a. m.	N.NW	0.8	2.75		
	7 a. m.				29.166	42
	9 a. m.	NW	2.4	2.85		
	2 p. m.				29.230	43
	3 p. m.	E.SE	1.6	2.92		
	9 p. m.			2.92	29.356	36
23	3 a. m.					
	7 a. m.				29.562	37
	9 a. m.	NE	1.4			
	2 p. m.				29.617	37
	3 p. m.	E.NE	0.8			
	9 p. m.	N.NE	1.8	3.03	29.651	35

TABLE AA.—*Showing the wind, water, barometer, &c.*—**Continued.**

Date.	Hour of day.	WIND.		Height of water below 1838.	Barometer reduced to 32°.	Therm'r detached.
		Course.	Relative velocity.			
1862. April 24	3 a. m.	NE	1.8	2.95		
	7 a. m.				29.631	35
	9 a. m.	NE	2.2	2.83		
	2 p. m.				29.624	40
	3 p. m.	N. NE	2.0	2.76		
	9 p. m.	Calm	0.0	2.82	29.591	34
25	3 a. m.	Calm	0.0	2.82		
	7 a. m.				29.547	36
	9 a. m.	S. SW	1.9	2.79		
	2 p. m.				29.451	59
	3 p. m.	West	2.6	2.68		
	9 p. m.	N. NE	1.5	2.74	29.501	43
26	3 a. m.	N. NE	1.5	2.74		
	7 a. m.				29.599	38
	9 a. m.	N. NE	1.4	2.74		
	2 p. m.				29.611	43
	3 p. m.	E. NE	0.6	2.72		
	9 p. m.	Calm	0.0	2.79		41
27	3 a. m.	S. SE	0.8	2.88		
	7 a. m.				29.405	53
	9 a. m.	W. SW	2.7	2.84		
	2 p. m.				29.411	53
	3 p. m.	SW	1.4	2.79		
	9 p. m.	W. SW	1.1	2.82	29.413	44
28	3 a. m.	W. SW	0.5	2.85		
	7 a. m.				29.414	44
	9 a. m.	West	0.5	2.94		
	2 p. m.				29.451	52
	3 p. m.	W. NW	0.6	2.89		
	9 p. m.	E. NE	1.6	2.91	29.548	42
29	3 a. m.	Calm	0.0	2.96		
	7 a. m.				29.627	42
	9 a. m.	E. SE	0.5	2.97		
	2 p. m.				29.577	49
	3 p. m.	SE	0.7	2.94		
	9 p. m.	Calm	0.0	2.88	29.534	46
30	3 a. m.	Calm	0.0	2.83		
	7 a. m.				29.432	47
	9 a. m.	S. SW	1.1	2.85		
	2 p. m.				29.277	54
	3 p. m.			2.74		
	9 p. m.	SE	0.6	2.67	29.179	48
May 1	3 a. m.	SE	1.0	2.72		
	7 a. m.				28.906	48
	9 a. m.	SW	0.3	2.68		
	2 p. m.				28.920	49
	3 p. m.	SW	0.7	2.60		
	9 p. m.	W. SW	0.3	2.51	28.983	43
2	3 a. m.	N. NE	0.9	2.50		
	7 a. m.				29.143	40
	9 a. m.	N. NE	1.0	2.67		
	2 p. m.				29.289	49
	3 p. m.	NW	0.1	2.80		
	9 p. m.	Calm	0.0	2.89	29.352	44
3	3 a. m.	Calm	0.0	2.93		
	7 a. m.				29.382	46
	9 a. m.	E. SE	0.2	3.04		
	2 p. m.				29.369	56
	3 p. m.	SE	0.3	3.04		
	9 p. m.	W. SW	0.1	3.00	29.306	50
4	3 a. m.	NW	0.1	2.94		
	7 a. m.				29.302	47
	9 a. m.	NW	0.6	2.95		
	2 p. m.				29.209	61
	3 p. m.	SE	1.3	2.80		
	9 p. m.	N. NE	2.3	2.82	29.304	40
5	3 a. m.	N. NW	0.1	2.85		
	7 a. m.				29.360	43
	9 a. m.	N. NE	4.3	2.87		
	2 p. m.				29.427	51
	3 p. m.	N. NE	2.5	2.90		
	9 p. m.	N. NE	0.7	2.91	29.433	43
1862. May 6	3 a. m.	Calm	0.0	2.92		
	7 a. m.				29.507	46
	9 a. m.	E. NE	0.3	2.97		
	2 p. m.				29.462	57
	3 p. m.	E. SE	0.1	2.99		
	9 p. m.	W. SW	0.1	3.01	29.401	43
7	3 a. m.	N. NW	0.7	3.00		
	7 a. m.				29.464	60
	9 a. m.	N. NW	1.3	2.97		
	2 p. m.				29.494	58
	3 p. m.	E. NE	0.5	2.92		
	9 p. m.	Calm	0.0	2.82	29.518	48
8	3 a. m.	Calm	0.0	2.84		
	7 a. m.				29.632	51
	9 a. m.	E. SE	0.2	2.80		
	2 p. m.				29.576	60
	3 p. m.	E. SE	1.7	2.88		
	9 p. m.	Calm	0.0	2.87	29.539	55
9	3 a. m.	Calm	0.0	2.94		
	7 a. m.				29.566	60
	9 a. m.	W. SW	1.1	2.90		
	2 p. m.				29.518	76
	3 p. m.	SE	1.0	2.95		
	9 p. m.	Calm	0.0	2.90	29.481	68
10	3 a. m.	West	0.5	2.96		
	7 a. m.				29.508	65
	9 a. m.	NW	1.7	2.88		
	2 p. m.				29.473	73
	3 p. m.	NE	1.1	2.90		
	9 p. m.	Calm	0.0	2.76	29.501	57
11	3 a. m.	N. NE	0.2	2.79		
	7 a. m.				29.608	57
	9 a. m.	E. SE	0.8	2.71		
	2 p. m.				29.594	61
	3 p. m.	E. SE	0.7	2.76		
	9 p. m.	Calm	0.0	2.68	29.551	55
12	3 a. m.	SW	0.1	2.78		
	7 a. m.				29.484	68
	9 a. m.	SW	2.7	2.81		
	2 p. m.				29.400	82
	3 p. m.	SW	2.7	2.89		
	9 p. m.	SW	0.1	2.84	29.328	66
13	3 a. m.	W. SW	0.2	2.84		
	7 a. m.				29.271	65
	9 a. m.	N. NE	3.4	2.68		
	2 p. m.				29.391	50
	3 p. m.	N. NE	3.5	2.56		
	9 p. m.	N. NE	3.9	2.50	29.411	47
14	3 a. m.	N. NE	2.7	2.54		
	7 a. m.				29.471	45
	9 a. m.	N. NE	0.4	2.73		
	2 p. m.				29.461	54
	3 p. m.	Calm	0.0	2.71		
	9 p. m.	Calm	0.0	2.74	29.451	46
15	3 a. m.	Calm	0.0	2.71		
	7 a. m.				29.447	53
	9 a. m.	SE	0.4	2.77		
	2 p. m.				29.407	63
	3 p. m.	E. SE	1.3	2.65		
	9 p. m.	Calm	0.0	2.73	29.364	56
16	3 a. m.	Calm	0.0	2.71		
	7 a. m.				29.399	61
	9 a. m.	E. SE	0.6	2.78		
	2 p. m.				29.348	70
	3 p. m.	E. SE	0.1	2.63		
	9 p. m.	W. NW	0.6	2.74	29.363	65
17	3 a. m.	Calm	0.0	2.69		
	7 a. m.				29.276	69
	9 a. m.	E. SE	0.6	2.78		
	2 p. m.				29.196	66
	3 p. m.	N. NE	1.6	2.67		
	9 p. m.	N. NE	1.7	2.58	29.151	49

TABLE AA.—*Showing the wind, water, barometer, &c.*—Continued.

Date.	Hour of day.	WIND.		Height of water below 1838.	Barometer reduced to 32°.	Therm'r detached.	Date.	Hour of day.	WIND.		Height of water below 1838.	Barometer reduced to 32°.	Therm'r detached.
		Course.	Relative velocity.						Course.	Relative velocity.			
1862. May 18	3 a. m.	N. NE	18	2.48			1862. May 30	3 a. m.	NE	1.1	3.42		
	7 a. m.				29.103	46		7 a. m.				29.098	49
	9 a. m.	NW	2.5	2.59				9 a. m.	NE	1.6	2.41		
	2 p. m.				29.318	49		2 p. m.				29.115	49
	3 p. m.	NW	1.3	2.46				3 p. m.	N. NE	2.9	2.36		
	9 p. m.	N. NE	0.1	2.60	29.381	40		9 p. m.	N. NE	1.8	2.38	29.141	49
19	3 a. m.	North	0.1	2.67			31	3 a. m.	N. NE	1.8	2.32		
	7 a. m.				29.381	38		7 a. m.				29.190	47
	9 a. m.	NE	0.6	2.77				9 a. m.	N. NE	2.0	2.43		
	2 p. m.				29.386	44		2 p. m.				29.184	50
	3 p. m.	E. SE	0.6	2.84				3 p. m.	NE	2.0	2.41		
	9 p. m.	Calm	0.0	2.83	29.347	39		9 p. m.	N. NE	0.7	2.51	29.164	53
20	3 a. m.	Calm	0.0	2.80			June 1	3 a. m.	N. NE	2.4	2.41		
	7 a. m.				29.355	45		7 a. m.				29.143	53
	9 a. m.	East	0.2	2.78				9 a. m.	N. NE	2.8	2.48		
	2 p. m.				29.292	48		2 p. m.				29.145	59
	3 p. m.	NE	0.3	2.67				3 p. m.	N. NE	1.6	2.45		
	9 p. m.	NE	1.5	2.52	29.166	46		9 p. m.	Calm	0.0	2.53	29.135	54
21	3 a. m.	N. NE	2.2	2.43			2	3 a. m.	N. NE	0.9	2.45		
	7 a. m.				29.941	43		7 a. m.				29.182	55
	9 a. m.	N. NE	3.7	2.28				9 a. m.	N. NE	6.5	2.47		
	2 p. m.				28.910	47		2 p. m.				29.234	62
	3 p. m.	West	2.5	2.44				3 p. m.	N. NE	6.8	2.41		
	9 p. m.	West	0.8	2.38	29.193	47		9 p. m.	N. NE	7.7	2.40	29.304	51
22	3 a. m.	W. SW	0.9	2.61			3	3 a. m.	N. NE	5.5	2.34		
	7 a. m.				29.362	56		7 a. m.				29.410	50
	9 a. m.	SW	1.9	2.70				9 a. m.	N. NE	5.5	2.34		
	2 p. m.				29.316	73		2 p. m.				29.436	53
	3 p. m.	SW	3.6	2.90				3 p. m.	N. NE	7.1	2.29		
	9 p. m.	NW	0.7	2.73	29.476	58		9 p. m.	N. NE	3.3	2.30	29.486	50
23	3 a. m.	Calm	0.0	2.94			4	3 a. m.	N. NE	2.5	2.31		
	7 a. m.				29.642	54		7 a. m.				29.537	49
	9 a. m.	NE	0.9	2.81				9 a. m.	N. NE	5.0	2.38		
	2 p. m.				29.672	49		2 p. m.				29.529	59
	3 p. m.	NE	0.7	2.85				3 p. m.	N. NE	6.2	2.36		
	9 p. m.	N. NE	1.0	2.68	29.682	43		9 p. m.	N. NE	2.9	2.39	29.509	58
24	3 a. m.	N. NE	0.9	2.69			5	3 a. m.	Calm	0.0	2.44		
	7 a. m.				29.743	48		7 a. m.				29.594	54
	9 a. m.	Calm	0.0	2.61				9 a. m.	N. NE	0.9	2.50		
	2 p. m.				29.659	53		2 p. m.				29.524	65
	3 p. m.	E. SE	0.7	2.64				3 p. m.	N. NE	0.5	2.48		
	9 p. m.	Calm	0.0	2.61	29.589	48		9 p. m.	N. NE	6.1	2.50	29.486	55
25	3 a. m.	Calm	0.0	2.67			6	3 a. m.	Calm	0.0	2.53		
	7 a. m.				29.444	57		7 a. m.				29.451	64
	9 a. m.	S. SE	2.0	2.71				9 a. m.	W. NW	1.0	2.54		
	2 p. m.				29.399	68		2 p. m.				29.330	77
	3 p. m.	S. SW	2.2	2.74				3 p. m.	N. NE	3.3	2.44		
	9 p. m.	S. SW	1.6	2.58	29.369	61		9 p. m.	N. NE	6.1	2.40	29.436	48
26	3 a. m.	S. SW	5.9	2.74			7	3 a. m.	N. NE	3.5	2.46		
	7 a. m.				29.159	60		7 a. m.				29.504	50
	9 a. m.	SW	4.0	2.74				9 a. m.	N. NE	1.1	2.41		
	2 p. m.				29.065	76		2 p. m.				29.512	57
	3 p. m.	SW	2.6	2.65				3 p. m.	N. NE	5.0	2.41		
	9 p. m.	N. NE	2.8	2.54	29.050	68		9 p. m.	N. NE	3.5	2.40	29.534	56
27	3 a. m.	N. NE	5.9	2.56			8	3 a. m.	N. NE	0.5	2.51		
	7 a. m.				29.211	44		7 a. m.				29.622	53
	9 a. m.	N. NE	4.3	2.59				9 a. m.	N. NE	2.4	2.49		
	2 p. m.				29.283	57		2 p. m.				29.607	59
	3 p. m.	N. NE	4.6	2.65				3 p. m.	East	0.2	2.55		
	9 p. m.	N. NE	3.9	2.67	29.306	47		9 p. m.	Calm	0.0	2.51	29.589	54
28	3 a. m.	N. NE	3.2	2.58			9	3 a. m.	Calm	0.0	2.55		
	7 a. m.				29.447	46		7 a. m.				29.614	60
	9 a. m.	N. NE	2.6	2.59				9 a. m.	W. SW	2.1	2.56		
	2 p. m.				29.424	53		2 p. m.				29.533	81
	3 p. m.	N. NE	2.4	2.60				3 p. m.	W. NW	2.1	2.59		
	9 p. m.	Calm	0.0	2.60	29.504	45		9 p. m.	W. SW	0.5	2.53	29.513	68
29	3 a. m.	Calm	0.0	2.54			10	3 a. m.	West	0.4	2.57		
	7 a. m.				29.387	53		7 a. m.				29.538	68
	9 a. m.	E. SE	0.7	2.61				9 a. m.	W. NW	1.3	2.53		
	2 p. m.				29.312	54		2 p. m.				29.420	82
	3 p. m.	East	0.2	2.59				3 p. m.	SW	1.2	2.56		
	9 p. m.	NE	0.5	2.53	29.263	50		9 p. m.	Calm	0.0	2.51	29.350	68

TABLES AA.—*Showing the wind, water, barometer, &c.*—Continued.

Date.	Hour of day.	WIND.		Height of water below 1838.	Barometer reduced to 32°.	Therm'r detached.	Date.	Hour of day.	WIND.		Height of water below 1838.	Barometer reduced to 32°.	Therm'r detached.
		Course.	Relative ve-velocity.						Course.	Relative velocity.			
1862. June 11	3 a. m.	Calm	0.0	2.56			1862. June 23	3 a. m.	N. NE	1.3	2.25		
	7 a. m.				29.314	70		7 a. m.				29.396	55
	9 a. m.	W. SW.	1.8	2.60				9 a. m.	N. NE	1.1	2.30		
	2 p. m.				29.192	84		2 p. m.				29.396	58
	3 p. m.	S. SW	2.6	2.62				3 p. m.	N. NE	2.5	2.34		
	9 p. m.	SW	1.4	2.62	29.117	77		9 p. m.	N. NE	0.4	2.33	29.377	57
12	3 a. m.	W. SW.	1.2	2.61			24	3 a. m.	Calm	0.0	2.41		
	7 a. m.				29.122	76		7 a. m.				29.391	53
	9 a. m.	W. SW.	2.4	2.60				9 a. m.	N. NE	1.2	2.43		
	2 p. m.				29.109	86		2 p. m.				29.389	65
	3 p. m.	N. NE	3.7	2.47				3 p. m.	E. NE	0.2	2.44		
	9 p. m.	N. NE	1.5	2.53	29.238	51		9 p. m.	Calm	0.0	2.41	29.413	58
13	3 a. m.	N. NE	0.9	2.48			25	3 a. m.	Calm	0.0	2.44		
	7 a. m.				29.366	51		7 a. m.				29.464	62
	9 a. m.			2.54				9 a. m.	E. NE	0.3	2.45		
	2 p. m.				29.278	59		2 p. m.				29.458	66
	3 p. m.	N. NE	1.7	2.44				3 p. m.	E. SE	0.6	2.41		
	9 p. m.	N. NE	1.3	2.45	29.281	52		9 p. m.	Calm	0.0	2.40	29.438	60
14	3 a. m.	N. NE	0.7	2.39			26	3 a. m.	Calm	0.0	2.40		
	7 a. m.				29.269	55		7 a. m.				29.443	62
	9 a. m.	N. NE	2.0	2.36				9 a. m.	E. SE	1.1	2.43		
	2 p. m.				29.251	54		2 p. m.				29.393	70
	3 p. m.	N. NE	4.2	2.22				3 p. m.	E. SE	0.3	2.44		
	9 p. m.	N. NE	2.7	2.27	29.323	50		9 p. m.	Calm	0.0	2.43	29.356	64
15	3 a. m.	N. NE	4.0	2.21			27	3 a. m.	Calm	0.0	2.39		
	7 a. m.				29.512	50		7 a. m.				29.291	62
	9 a. m.	NE	2.2	2.30				9 a. m.	E. SE	1.0	2.44		
	2 p. m.				29.566	56		2 p. m.				29.268	68
	3 p. m.	N. NE	3.7	2.25				3 p. m.	E. SE	1.0	2.35		
	9 p. m.	E. NE	2.3	2.34	29.602	53		9 p. m.	Calm	0.0	2.36	29.218	65
16	3 a. m.	E. SE	2.3	2.27			28	3 a. m.	N. NE	0.1	2.32		
	7 a. m.				29.574	54		7 a. m.				29.241	61
	9 a. m.	E. SE	2.2	2.32				9 a. m.	N. NE	1.6	2.41		
	2 p. m.				29.486	63		2 p. m.				29.236	62
	3 p. m.	E. SE	2.3	2.26				3 p. m.	NE	1.4	2.37		
	9 p. m.	E. SE	0.8	2.24	29.344	59		9 p. m.	NE	0.1	2.41	29.223	64
17	3 a. m.	S. SW	2.4	2.31			29	3 a. m.	Calm	0.0	2.40		
	7 a. m.				29.196	67		7 a. m.				29.211	72
	9 a. m.	SW	3.6	2.49				9 a. m.	W.NW.	2.0	2.49		
	2 p. m.				29.077	76		2 p. m.				29.202	83
	3 p. m.	SW	3.5	2.47				3 p. m.	N. NW	1.3	2.46		
	9 p. m.	W. SW.	2.1	2.54	29.040	68		9 p. m.	West	1.4	2.51	29.198	72
18	3 a. m.	W. SW.	1.1	2.54			30	3 a. m.	N. NW	2.7	2.48		
	7 a. m.				29.008	62		7 a. m.				29.331	60
	9 a. m.	N. NE	4.2	2.40				9 a. m.	N. NE	5.1	2.52		
	2 p. m.				29.166	47		2 p. m.				29.371	60
	3 p. m.	N. NE	4.2	2.31				3 p. m.	NE	2.5	2.53		
	9 p. m.	N. NE	0.9	2.41	29.301	47		9 p. m.	Calm	0.0	2.56	29.326	55
19	3 a. m.	NW	0.1	2.40			July 1	3 a. m.	Calm	0.0	2.69		
	7 a. m.				29.350	50		7 a. m.				29.294	61
	9 a. m.	N.NW	0.6	2.45				9 a. m.	SE	1.1	2.74		
	2 p. m.				29.320	59		2 p. m.				29.165	74
	3 p. m.	E.SE	1.0	2.51				3 p. m.	W. SW.	2.2	2.69		
	9 p. m.	W. SW.	0.2	2.55	29.282	57		9 p. m.	SW	0.3	2.66	29.100	67
20	3 a. m.	W.SW	0.4	2.59			2	3 a. m.	Calm	0.0	2.54		
	7 a. m.				29.279	59		7 a. m.				29.143	69
	9 a. m.	W.SW	2.0	2.56				9 a. m.			2.58		
	2 p. m.				29.241	72		2 p. m.				29.221	66
	3 p. m.	West	1.4	2.51				3 p. m.			2.51		
	9 p. m.	NW	0.5	2.39	29.303	61		9 p. m.	Calm	0.0	2.54	29.173	56
21	3 a. m.	N. NE	0.2	2.45			3	3 a. m.	Calm	0.0	2.50		
	7 a. m.				29.361	57		7 a. m.				29.431	68
	9 a. m.	W.SW	1.2	2.45				9 a. m.	E. SE	0.8	2.60		
	2 p. m.				29.385	75		2 p. m.				29.481	72
	3 p. m.	N. NE	2.1	2.40				3 p. m.	SE	1.3	2.58		
	9 p. m.	N. NE	0.6	2.36	29.491	52		9 p. m.	S. SW	0.5	2.60	29.501	70
22	3 a. m.	N. NE	0.3	2.39			4	3 a. m.	S. SE	0.2	2.60		
	7 a. m.				29.536	57		7 a. m.				29.623	74
	9 a. m.	E. NE	0.5	2.34				9 a. m.	S. SW	2.0	2.69		
	2 p. m.				29.524	57		2 p. m.				29.537	84
	3 p. m.	N. NE	2.6	2.29				3 p. m.	South	2.8	2.64		
	9 p. m.	N. NE	2.5	2.22	29.449	52		9 p. m.	South	1.1	2.67	29.547	77

TABLE AA.—*Showing the wind, water, barometer, &c.*—Continued.

Date.	Hour of day.	WIND.		Height of water below 1838.	Barometer reduced to 32°.	Therm'r detached.
		Course.	Relative velocity.			
1862. July 5	3 a. m.	S. SW	0.1	2.71		
	7 a. m.				29.568	74
	9 a. m.	SW	2.6	2.77		
	2 p. m.				29.499	91
	3 p. m.	SW	3.1	2.78		
	9 p. m.	S. SW	0.7	2.77	29.451	80
6	3 a. m.			2.79		
	7 a. m.				29.502	81
	9 a. m.	N. NE	0.4	2.74		
	2 p. m.				29.527	74
	3 p. m.	N. NE	3.0	2.75		
	9 p. m.	Calm	0.0	2.67	29.470	72
7	3 a. m.	Calm	0.0	2.71		
	7 a. m.				29.333	75
	9 a. m.	N. NW	1.2	2.63		
	2 p. m.				29.225	82
	3 p. m.	W. SW	1.1	2.73		
	9 p. m.	Calm	0.0	2.67	29.212	71
8	3 a. m.	Calm	0.0	2.75		
	7 a. m.				29.200	73
	9 a. m.			2.71		
	2 p. m.				29.132	78
	3 p. m.	E. SE	1.0	2.72		
	9 p. m.	SW	1.3	2.68	29.082	68
9	3 a. m.	West	0.3	2.67		
	7 a. m.				29.168	69
	9 a. m.	N. NE	2.4	2.58		
	2 p. m.				29.263	68
	3 p. m.	N. NE	1.4	2.65		
	9 p. m.	N. NE	0.5	2.75	29.328	64
10	3 a. m.	Calm	0.0	2.70		
	7 a. m.				29.448	64
	9 a. m.	N. NE	2.0	2.66		
	2 p. m.				29.468	69
	3 p. m.	N. NE	1.8	2.63		
	9 p. m.	Calm	0.0	2.58	29.483	61
11	3 a. m.	Calm	0.0	2.59		
	7 a. m.				29.528	64
	9 a. m.	E. NE	0.2	2.64		
	2 p. m.				29.498	78
	3 p. m.	SE	0.5	2.65		
	9 p. m.	Calm	0.0	2.70	29.423	69
12	3 a. m.			2.73		
	7 a. m.				29.368	69
	9 a. m.	W. SW	1.5	2.81		
	2 p. m.				29.180	75
	3 p. m.	SW	2.3	2.77		
	9 p. m.	SW	1.1	2.82	29.117	74
13	3 a. m.	W. SW	1.9	2.82		
	7 a. m.				29.050	72
	9 a. m.	W. SW	0.7	2.80		
	2 p. m.				29.060	74
	3 p. m.			2.70		
	9 p. m.	Calm	0.0	2.72	29.047	69
14	3 a. m.	Calm	0.0	2.70		
	7 a. m.				29.082	67
	9 a. m.	SE	0.5	2.62		
	2 p. m.				29.072	76
	3 p. m.	SW	1.6	2.48		
	9 p. m.	SW	0.3	2.48	29.094	73
15	3 a. m.	Calm	0.0	2.47		
	7 a. m.				29.213	69
	9 a. m.	West	1.2	2.59		
	2 p. m.				29.255	78
	3 p. m.	W. NW	1.9	2.57		
	9 p. m.	N. NE	0.8	2.64	29.330	62
16	3 a. m.	N. NE	3.0	2.60		
	7 a. m.				29.403	58
	9 a. m.	N. NE	2.5	2.66		
	2 p. m.				29.436	61
	3 p. m.	N. NE	2.5	2.55		
	9 p. m.	N. NE	0.5	2.52	29.421	56
1862. July 17	3 a. m.	NE	0.1	2.43		
	7 a. m.				29.386	63
	9 a. m.	E. NE	0.4	2.49		
	2 p. m.				29.378	63
	3 p. m.	NE	2.5	2.43		
	9 p. m.	E. NE	0.6	2.43	29.343	61
18	3 a. m.	SE	0.3	2.39		
	7 a. m.				29.318	62
	9 a. m.	SE	0.5	2.49		
	2 p. m.				29.253	70
	3 p. m.	SE	0.4	2.44		
	9 p. m.	SW	0.5	2.47	29.201	67
19	3 a. m.	SW	0.7	2.46		
	7 a. m.				29.176	71
	9 a. m.	W. SW	1.5	2.48		
	2 p. m.				29.254	85
	3 p. m.	W. NW	1.5	2.52		
	9 p. m,	NW	0.2	2.50	29.185	74
20	3 a. m.	Calm	0.0	2.60		
	7 a. m.				29.286	67
	9 a. m.	NW	0.9	2.65		
	2 p. m.				29.272	80
	3 p. m.	N. NW	2.3	2.70		
	9 p. m.	NW	0.1	2.66	29.285	72
21	3 a. m.	NW	0.1	2.71		
	7 a. m.				29.305	72
	9 a. m.	E. NE	0.6	2.65		
	2 p. m.				29.338	76
	3 p. m.	SE	1.3	2.58		
	9 p. m.	E. SE	0,3	2.50	29.278	70
22	3 a. m.	SW	0.6	2.53		
	7 a. m.				29.218	73
	9 a. m.	W. NW	1.4	2.51		
	2 p. m.				29.210	80
	3 p. m.	SE	1.1	2.57		
	9 p. m.	W. NW	1.1	2.52	29.205	71
23	3 a. m.	W. NW	1.2	2.65		
	7 a. m.				29.248	66
	9 a. m.	NW	3.7	2.68		
	2 p. m.				29.245	79
	3 p. m.	W. NW	3.1	2.73		
	9 p. m.	W. NW	0.9	2.68	29.215	71
24	3 a. m.	W. NW	0.6	2.68		
	7 a. m.				29.263	66
	9 a. m.	N. NW	2.5	2.68		
	2 p. m.				29.280	74
	3 p. m.	N. NW	2.1	2.59		
	9 p. m.	SE	0.1	2.60	29,300	66
25	3 a. m.	Calm	0.0	2.62		
	7 a. m.				29.363	63
	9 a. m.	W. NW	1.2	2.70		
	2 p. m.				29.293	75
	3 p. m.	SE	1.4	2.67		
	9 p. m.	Calm	0.0	2.66	29.353	66
26	3 a. m.	Calm	0.0	2.61		
	7 a. m.					66
	9 a. m.	E. SE	0.5	2.64		
	2 p. m.				29.360	79
	3 p. m.	S. SE	1.5	2.57		
	9 p. m.	S. SW	0.2	2.60	29.380	68
27	3 a. m.	W. SW	0.2	2.59		
	7 a. m.				29.411	70
	9 a. m.	SW	1.8	2.64		
	2 p. m.				29.327	83
	3 p. m.	SW	3.0	2.63		
	9 p. m.	S. SW	0.1	2.63	29.310	74
28	3 a. m.	W. SW	1.1	2.64		
	7 a. m.				29.273	72
	9 a. m.	W. NW	3.2	2.73		
	2 p. m.				29.189	87
	3 p. m.	W. NW	3.9	2.63		
	9 p. m.	W. NW	0.3	2.65	29.247	73

TABLE AA.—*Showing the wind, water, barometer, &c.*—Continued.

Date.	Hour of day.	WIND.		Height of water below 1838.	Barometer reduced to 32°.	Therm'r detached.	Date.	Hour of day.	WIND.		Height of water below 1838.	Barometer reduced to 32°.	Therm'r detached.
		Course.	Relative velocity.						Course.	Relative velocity.			
1862. July 29	3 a. m.	NW	0.2	2.66	......	....	1862. Aug. 10	3 a. m.	......	....	......	......	....
	7 a. m.	......	....	......	29.333	67		7 a. m.	......	....	......	29.313	66
	9 a. m.	N. NW	1.4	2.70	......	....		9 a. m.	SE	0.3	......	......	....
	2 p. m.	......	....	......	29.325	76		2 p. m.	......	....	......	29.283	76
	3 p. m.	SE	1.6	2.61	......	....		3 p. m.	SE	0.7	2.50	......	....
	9 p. m.	Calm	0.0	2.68	29.380	68		9 p. m.	S. SE	0.3	2.43	29.200	73
30	3 a. m.	Calm	0.0	2.64	......	....	11	3 a. m.	SW	0.1	2.42	......	....
	7 a. m.	......	....	......	29.463	68		7 a. m.	......	....	......	29.153	78
	9 a. m.	E. NE	1.0	2.68	......	....		9 a. m.	......	....	2.49	......	....
	2 p. m.	......	....	......	29.473	77		2 p. m.	......	....	......	29.229	85
	3 p. m.	E. SE	0.9	2.59	......	....		3 p. m.	W. SW	3.2	2.52	......	....
	9 p. m.	Calm	0.0	2.63	29.358	67		9 p. m.	NW	0.1	2.62	29.392	69
31	3 a. m.	Calm	0.0	2.53	......	....	12	3 a. m.	Calm	0.0	2.59	......	....
	7 a. m.	......	....	......	29.483	68		7 a. m.	......	....	......	29.548	65
	9 a. m.	NE	0.4	2.59	......	....		9 a. m.	North	0.2	2.67	......	....
	2 p. m.	......	....	......	29.495	79		2 p. m.	......	....	......	29.578	71
	3 p. m.	E. SE	0.7	2.51	......	....		3 p. m.	E. SE	0.4	2.55	......	....
	9 p. m.	Calm	0.0	2.54	29.463	70		9 p. m.	Calm	0.0	2.60	29.583	64
Aug. 1	3 a. m.	Calm	0.0	2.54	......	....	13	3 a. m.	Calm	0.0	2.53	......	....
	7 a. m.	......	....	......	29.483	71		7 a. m.	......	....	......	29.571	63
	9 a. m.	N. NE	1.2	2.64	......	....		9 a. m.	SE	0.2	2.55	......	....
	2 p m.	......	....	......	29.492	80		2 p. m.	......	....	......	29.505	75
	3 p. m.	SE	0.5	2.62	......	....		3 p. m.	SE	0.2	2.43	......	....
	9 p. m.	Calm	0.0	2.60	29.467	70		9 p. m.	W. SW	0.2	2.48	29.368	68
2	3 a. m.	Calm	0.0	2.61	......	....	14	3 a. m.	SW	0.2	2.46	......	....
	7 a. m.	......	....	......	29.478	68		7 a. m.	......	....	......	29.248	65
	9 a. m.	SE	1.4	2.64	......	....		9 a. m.	N. NE	0.8	2.53	......	....
	2 p. m.	......	....	......	29.370	76		2 p. m.	......	....	......	29.458	70
	3 p. m.	SE	0.7	2.59	......	....		3 p. m.	NE	1.5	2.49	......	....
	9 p. m.	SE	0.1	2.53	29.610	71		9 p. m.	Calm	0.0	2.55	29.448	60
3	3 a. m.	S. SE	0.5	2.51	......	....	15	3 a. m.	N. NW	0.1	2.66	......	....
	7 a. m.	......	....	......	29.097	73		7 a. m.	......	....	......	29.583	56
	9 a. m.	S. SW	0.6	2.57	......	....		9 a. m.	E. NE	0.6	2.69	......	....
	2 p. m.	......	....	......	29.054	81		2 p. m.	......	....	......	29.593	67
	3 p. m.	W. NW.	1.7	2.52	......	....		3 p. m.	East	1.1	2.63	......	....
	9 p. m.	Calm	0.0	2.59	29.135	72		9 p. m.	Calm	0.0	2.63	29.598	59
4	3 a. m.	Calm	0.0	2.60	......	....	16	3 a. m.	Calm	0.0	2.57	......	....
	7 a. m.	......	....	......	29.210	72		7 a. m.	......	....	......	29.702	59
	9 a. m.	SE	0.7	2.66	......	....		9 a. m.	SW	1.1	2.56	......	....
	2 p. m.	......	....	......	29.222	75		2 p. m.	......	....	......	29.680	70
	3 p. m.	S. SE	1.2	2.65	......	....		3 p. m.	SW	1.4	2.55	......	....
	9 p. m.	W. NW.	0.5	2.50	29.225	68		9 p. m.	S. SW	0.8	2.56	29.639	64
5	3 a. m.	Calm	0.0	2.54	......	....	17	3 a. m.	SW	0.7	2.56	......	....
	7 a. m.	......	....	......	29.405	63		7 a. m.	......	....	......	29.661	62
	9 a. m.	NW	0.2	2.59	......	....		9 a. m.	SW	2.7	2.73	......	....
	2 p. m.	......	....	......	29.433	70		2 p. m.	......	....	......	29.495	73
	3 p. m.	......	....	2.67	......	....		3 p. m.	SW	2.6	2.75	......	....
	9 p. m.	Calm	0.0	2.63	29.458	66		9 p. m.	SW	0.2	2.65	29.478	68
6	3 a. m.	Calm	0.0	2.71	......	....	18	3 a. m.	N. NE	1.0	2.68	......	....
	7 a. m.	......	....	......	29.543	65		7 a. m.	......	....	......	29.535	65
	9 a. m.	......	....	2.60	......	....		9 a. m.	NE	2.5	2.65	......	....
	2 p. m.	......	....	......	29.473	72		2 p. m.	......	....	......	29.493	71
	3 p. m.	......	....	2.65	......	....		3 p. m.	NE	2.8	2.58	......	....
	9 p. m.	......	....	......	29.373	68		9 p. m.	N. NE	0.1	2.53	29.451	60
7	3 a. m.	SW	0.4	2.48	......	....	19	3 a. m.	......	....	2.57	......	....
	7 a. m.	......	....	......	29.340	79		7 a. m.	......	....	......	29.496	60
	9 a. m.	SW	0.7	2.57	......	....		9 a. m.	SE	0.6	2.59	......	....
	2 p. m.	......	....	......	29.294	90		2 p. m.	......	....	......	29.378	76
	3 p. m.	......	....	2.53	......	....		3 p. m.	SE	1.7	2.62	......	....
	9 p. m.	......	....	......	29.247	82		9 p. m.	SW	0.3	2.61	29.393	70
8	3 a. m.	......	....	......	......	....	20	3 a. m.	W. SW.	0.1	2.63	......	....
	7 a. m.	......	....	......	29.260	81		7 a. m.	......	....	......	29.418	62
	9 a. m.	......	....	......	......	....		9 a. m.	West	1.5	2.57	......	....
	2 p. m.	......	....	......	29.569	90		2 p. m.	......	....	......	29.387	82
	3 p. m.	......	....	......	......	....		3 p. m.	South	1.3	2.52	......	....
	9 p. m.	W. NW.	0.8	......	29.104	91		9 p. m.	Calm	0.0	2.49	29.391	69
9	3 a. m.	W. NW.	0.2	......	......	....	21	3 a. m.	Calm	0.0	2.51	......	....
	7 a. m.	......	....	......	29.180	66		7 a. m.	......	....	......	29.388	65
	9 a. m.	N. NE	1.2	......	......	....		9 a. m.	SE	0.5	2.48	......	....
	2 p. m.	......	....	......	29.258	70		2 p. m.	......	....	......	20.358	73
	3 p. m.	......	....	......	......	....		3 p. m.	SE	0.8	2.50	......	....
	9 p. m.	......	....	......	29.278	65		9 p. m.	S. SW	0.5	2.45	29.153	70

TABLE AA.—*Showing the wind, water, barometer, &c.*—Continued.

Date.	Hour of day.	WIND.		Height of water below 1838.	Barometer reduced to 32°.	Therm'r detached.
		Course.	Relative velocity.			
1862. Aug. 22	3 a. m.	W. NW.	1.9	2.52		
	7 a. m.				29.153	69
	9 a. m.	NW	2.3	2.56		
	2 p. m.				29.248	74
	3 p. m.	W. NW.	2.4	2.62		
	9 p. m.	W. NW.	0.3	2.70	29.325	66
23	3 a. m.	W. NW.	0.9	2.72		
	7 a. m.				29.431	66
	9 a. m.	N. NE.	4.2	2.62		
	2 p. m.				29.568	66
	3 p. m.	N. NE.	4.7	2.51		
	9 p. m.	N. NE.	1.1	2.48	29.598	57
24	3 a. m.	E. NE.	0.2	2.45		
	7 a. m.				29.596	63
	9 a. m.	SE	1.9	2.42		
	2 p. m.				29.536	73
	3 p. m.	S. SE	2.4	2.49		
	9 p. m.	S. SW	0.5	2.46	29.476	67
25	3 a. m.	SW	0.4	2.55		
	7 a. m.				29.421	69
	9 a. m.	SW	2.0	2.60		
	2 p. m.				29.327	86
	3 p. m.	SW	2.2	2.66		
	9 p. m.	S. SW	0.2	2.66	29.325	73
26	3 a. m.	SW	0.2	2.65		
	7 a. m.				29.285	73
	9 a. m.	SW	1.1	2.61		
	2 p. m.				29.207	89
	3 p. m.	S. SW	2.5	2.51		
	9 p. m.	NW	0.3	2.59		73
27	3 a. m.	W. NW.	0.8	2.55		
	7 a. m.				29.260	68
	9 a. m.	N. NW.	2.5	2.55		
	2 p. m.				29.262	75
	3 p. m.	NE	1.2	2.48		
	9 p. m.	W. NW.	0.4	2.57	29.230	66
28	3 a. m.	NW	1.0	2.57		
	7 a. m.				29.353	66
	9 a. m.	NW	1.9	2.67		
	2 p. m.				29.334	84
	3 p. m.	W. NW.	2.0	2.67		
	9 p. m.	NW	2.9	2.67	29.352	73
29	3 a. m.	N. NE.	1.2	2.59		
	7 a. m.				29.483	66
	9 a. m.	N. NE.	3.2	2.58		
	2 p. m.				29.553	70
	3 p. m.	NE	3.1	2.46		
	9 p. m.	N. NE.	0.7	2.48	29.545	61
30	3 a. m.	E. NE.	0.5	2.47		
	7 a. m.				29.581	66
	9 a. m.	SE	1.7	2.52		
	2 p. m.				29.524	73
	3 p. m.	SE	1.0	2.49		
	9 p. m.	Calm	0.0	2.53	29.440	67
31	3 a. m.	S. SW	0.5	2.53		
	7 a. m.				29.303	68
	9 a. m.	SW	1.3	2.63		
	2 p. m.				29.097	78
	3 p. m.	SW	3.3	2.57		
	9 p. m.	W. NW.	1.2	2.60	29.052	71
Sept. 1	3 a. m.	W. NW.	1.9	2.70		
	7 a. m.				29.090	63
	9 a. m.	North	2.8	2.60		
	2 p. m.				29.183	61
	3 p. m.	NE	4.2	2.58		
	9 p. m.	N. NE.	3.3	2.61	29.363	53
2	3 a. m.	N. NW.	0.4	2.68		
	7 a. m.				29.489	47
	9 a. m.	E. SE	0.8	2.61		
	2 p. m.				29.452	60
	3 p. m.	SE	1.9	2.63		
	9 p. m.	South	0.2	2.67	29.421	54
1862. Sept. 3	3 a. m.	S. SW	0.4	2.75		
	7 a. m.				29.379	57
	9 a. m.	S. SW	2.6	2.79		
	2 p. m.				29.273	80
	3 p. m.	S. SW	3.0	2.86		
	9 p. m.	S. SW	2.6	2.85	29.278	75
4	3 a. m.	SW	2.4	2.92		
	7 a. m.				29.330	72
	9 a. m.	SW	2.7	2.98		
	2 p. m.				29.342	63
	3 p. m.	SW	1.9	3.05		
	9 p. m.	S. SW	0.2	2.97	29.355	73
5	3 a. m.	Calm	0.0	2.99		
	7 a. m.				29.350	72
	9 a. m.	Calm	0.0	2.86		
	2 p. m.				29.275	76
	3 p. m.	Calm	0.0	2.65		
	9 p. m.			2.39	29.315	60
6	3 a. m.			2.32		
	7 a. m.				29.359	57
	9 a. m.					
	2 p. m.				29.389	66
	3 p. m.					
	9 p. m.				29.213	62
7	3 a. m.					
	7 a. m.				29.293	62
	9 a. m.	SW	0.1	2.62		
	2 p. m.				29.203	76
	3 p. m.	SW	2.2	2.76		
	9 p. m.	NW	2.1	2.81	29.200	73
8	3 a. m.	W. SW.	0.4	2.82		
	7 a. m.				29.369	58
	9 a. m.	NW	2.4	2.88		
	2 p. m.				29.476	72
	3 p. m.	N. NW.	1.1	2.88		
	9 p. m.	Calm	0.0	2.82	29.556	59
9	3 a. m.	Calm	0.0	2.72		
	7 a. m.				29.636	57
	9 a. m.	S. SE	1.7	2.70		
	2 p. m.				29.576	69
	3 p. m.	SE	2.3	2.65		
	9 p. m.	Calm	0.0	2.57	29.531	60
10	3 a. m.	Calm	0.0	2.58		
	7 a. m.				29.524	58
	9 a. m.	SE	1.1	2.62		
	2 p. m.				29.428	72
	3 p. m.	SE	1.8	2.58		
	9 p. m.	W. SW.	0.5	2.57	29.368	67
11	3 a. m.	S. SE	0.5	2.52		
	7 a. m.				29.228	70
	9 a. m.	S. SW	2.0	2.62		
	2 p. m.				29.198	77
	3 p. m.	SW	2.2	2.61		
	9 p. m.	W. NW.	3.6	2.72	29.305	59
12	3 a. m.	NW	1.3	2.66		
	7 a. m.				29.591	50
	9 a. m.	N. NE.	2.7	2.72		
	2 p. m.				29.697	54
	3 p. m.	N. NE.	3.9	2.73		
	9 p. m.	NE	2.6	2.60	29.717	53
13	3 a. m.	E. SE	2.0	2.48		
	7 a. m.				29.708	55
	9 a. m.	SE	2.0	2.54		
	2 p. m.				29.611	62
	3 p. m.	SE	1.9	2.46		
	9 p. m.	Calm	0.0	2.44	29.558	53
14	3 a. m.	Calm	0.0	2.49		
	7 a. m.				29.551	58
	9 a. m.	SE	0.9	2.61		
	2 p. m.				29.481	69
	3 p. m.	S. SE	1.8	2.61		
	9 p. m.	S. SE	0.2	2.63	29.498	65

TABLE AA.—*Showing the wind, water, barometer, &c.*—Continued.

Date.	Hour of day.	WIND.		Height of water below 1838.	Barometer reduced to 32°.	Therm'r detached.	Date.	Hour of day.	WIND.		Height of water below 1838.	Barometer reduced to 32°.	Therm'r detached.
		Course.	Relative velocity.						Course.	Relative velocity.			
1862. Sept. 15	3 a. m.	N. NE	0.3	2.52	......	...	1862. Sept. 27	3 a. m.	Calm	0.0	2.63	......	...
	7 a. m.	......	...	......	29.578	59		7 a. m.	......	...	......	29.336	53
	9 a. m.	N. NE	4.7	2.42	......	...		9 a. m.	S. SE	1.1	2.64	......	...
	2 p. m.	......	...	......	29.611	60		2 p. m.	......	...	......	29.248	69
	3 p. m.	NE	5.4	2.41	......	...		3 p. m.	S. SE	1.7	2.59	......	...
	9 p. m.	NE	3.2	2.38	29.628	58		9 p. m.	S. SW	0.7	2.60	29.231	64
16	3 a. m.	East	1.1	2.39	......	...	28	3 a. m.	......	...	2.61	......	...
	7 a. m.	......	...	......	29.541	60		7 a. m.	......	...	......	29.253	61
	9 a. m.	E. SE	0.9	2.46	......	...		9 a. m.	SW	0.7	2.64	......	...
	2 p. m.	......	...	......	29.428	64		2 p. m.	......	...	......	29.248	71
	3 p. m.	E. SE	0.4	2.45	......	...		3 p. m.	N'rth	0.8	2.60	......	...
	9 p. m.	South	0.1	2.42	29.321	64		9 p. m.	N. NE	3.3	2.57	29.338	58
17	3 a. m.	......	...	2.38	......	...	29	3 a. m.	NE	3.4	2.50	......	...
	7 a. m.	......	...	......	29.256	65		7 a. m.	......	...	......	29.436	57
	9 a. m.	South	0.2	2.37	......	...		9 a. m.	NE	3.2	2.59	......	...
	2 p. m.	......	...	......	29.132	66		2 p. m.	......	...	......	29.410	59
	3 p. m.	South	0.3	2.30	......	...		3 p. m.	NE	2.9	......	......	...
	9 p. m.	Calm	0.0	2.40	29.075	64		9 p. m.	N. NE	0.5	......	29.416	56
18	3 a. m.	W. NW	1.5	2.55	......	...	30	3 a. m.	North	0.5	......	......	...
	7 a. m.	......	...	......	29.268	52		7 a. m.	......	...	......	29.418	54
	9 a. m.	W. NW	1.5	2.55	......	...		9 a. m.	N. NE	0.2	......	......	...
	2 p. m.	......	...	......	29.398	63		2 p. m.	......	...	......	29.363	61
	3 p. m.	NW	0.7	2.60	......	...		3 p. m.	E. NE	0.1	......	......	...
	9 p. m.	Calm	0.6	2.56	29.501	56		9 p. m.	Calm	0.0	......	29.330	62
19	3 a. m.	Calm	0.0	2.63	......	...	Oct. 1	3 a. m.	......	...	......	......	...
	7 a. m.	......	...	......	29.612	52		7 a. m.	......	...	......	29.383	59
	9 a. m.	South	0.5	2.58	......	...		9 a. m.	Calm	0.0	2.42	......	...
	2 p. m.	......	...	......	29.578	64		2 p. m.	......	...	......	29.328	64
	3 p. m.	SE	1.4	2.54	......	...		3 p. m.	SE	0.2	2.47	......	...
	9 p. m.	Calm	0.0	2.47	29.548	56		9 p. m.	E. SE	0.2	2.50	29.283	64
20	3 a. m.	W. SW	0.3	2.59	......	...	2	3 a. m.	W. NW.	0.1	2.52	......	...
	7 a. m.	......	...	......	29.489	58		7 a. m.	......	...	......	29.323	65
	9 a. m.	West	1.7	2.50	......	...		9 a. m.	N. NE	0.5	2.57	......	...
	2 p. m.	......	...	......	29.455	76		2 p. m.	......	...	......	29.376	68
	3 p. m.	SW	1.0	2.55	......	...		3 p. m.	E. SE	0.5	2.66	......	...
	9 p. m.	Calm	0.0	2.50	29.488	65		9 p. m.	Calm	0.0	2.62	29.388	64
21	3 a. m.	Calm	0.0	2.54	......	...	3	3 a. m.	S. SW	0.1	2.67	......	...
	7 a. m.	......	...	......	29.513	61		7 a. m.	......	...	......	29.343	61
	9 a. m.	S. SW	2.6	2.51	......	...		9 a. m.	S. SE	0.7	2.55	......	...
	2 p. m.	......	...	......	29.405	78		2 p. m.	......	...	......	......	78
	3 p. m.	S. SW	2.7	2.56	......	...		3 p. m.	S. SW	3.4	2.56	......	...
	9 p. m.	S. SW	2.6	2.54	29.400	68		9 p. m.	S. SW	4.3	2.61	29.070	75
22	3 a. m.	SW	2.1	2.66	......	...	4	3 a. m.	West	3.6	2.76	......	...
	7 a. m.	......	..	......	29.429	64		7 a. m.	......	...	......	29.268	55
	9 a. m.	SW	2.5	2.70	......	...		9 a. m.	W. NW.	5.0	2.88	......	...
	2 p. m.	......	...	......	29.385	67		2 p. m.	......	...	......	29.478	62
	3 p. m.	SW	0.5	2.69	......	...		3 p. m.	W. NW.	3.9	2.98	......	...
	9 p. m.	Calm	0.0	2.68	29.403	65		9 p. m.	W. NW.	0.5	3.00	29.666	51
23	3 a. m.	SW	1.0	2.67	......	...	Oct. 5	3 a. m.	Calm	0.0	3.08	......	...
	7 a. m.	......	...	......	29.335	66		7 a. m.	......	...	......	29.777	47
	9 a. m.	W. SW	2.5	2.61	......	...		9 a. m.	S. SE	1.8	2.94	......	...
	2 p. m.	......	...	......	29.303	68		2 p. m.	......	...	......	29.651	69
	3 p. m.	W. NW.	2.8	2.39	......	...		3 p. m.	S. SE	2.8	2.90	......	...
	9 p. m.	W. NW.	2.4	2.46	29.480	54		9 p. m.	S. SE	1.6	2.78	29.516	58
24	3 a. m.	N. NW	0.5	2.54	......	...	6	3 a. m.	S. SW	2.1	2.84	......	...
	7 a. m.	......	...	......	29.619	46		7 a. m.	......	...	......	29.128	60
	9 a. m.	NW	1.0	2.66	......	...		9 a. m.	SW	3.4	2.81	......	...
	2 p. m.	......	...	......	29.578	62		2 p. m.	......	...	......	29.061	73
	3 p. m.	West	...	2.68	......	...		3 p. m.	SW	2.5	2.83	......	...
	9 p. m.	SW	0.1	2.73	29.521	51		9 p. m.	SW	1.8	2.77	29.070	72
25	3 a. m.	W. SW	0.2	2.77	......	...	7	3 a. m.	SW	1.9	2.76	......	...
	7 a. m.	......	...	......	29.494	49		7 a. m.	......	...	......	29.060	70
	9 a. m.	SW	2.5	2.92	......	...		9 a. m.	SW	3.4	2.75	......	...
	2 p. m.	......	...	......	29.371	65		2 p. m.	......	...	......	28.977	81
	3 p. m.	SW	1.0	2.91	......	...		3 p. m.	S. SW	4.2	2.70	......	...
	9 p. m.	SW	0.3	2.92	29.396	53		9 p. m.	SW	5.5	2.77	28.230	76
26	3 a. m.	SW	0.1	2.83	......	...	8	3 a. m.	SW	2.3	2.73	......	...
	7 a. m.	......	...	......	29.419	50		7 a. m.	......	...	......	28.955	72
	9 a. m.	SW	1.1	2.87	......	...		9 a. m.	SW	4.8	2.93	......	...
	2 p. m.	......	...	......	29.378	70		2 p. m.	......	...	......	29.105	69
	3 p. m.	S. SE	2.0	2.76	......	...		3 p. m.	W. NW.	1.8	2.75	......	...
	9 p. m.	S. SW	0.1	2.73	29.368	57		9 p. m.	West	0.1	2.94	29.275	57

TABLE AA.—*Showing the wind, water, barometer, &c.*—Continued.

Date.	Hour of day.	WIND.		Height of water below 1838.	Barometer reduced to 32°.	Therm'r detached.
		Course.	Relative velocity.			
1862.						
Oct. 9	3 a. m.	Calm	0.0	2.84	......	...
	7 a. m.	......	...	......	29.509	49
	9 a. m.	N.NW	0.1	2.85	......	...
	2 p. m.	......	...	......	29.523	58
	3 p. m.	Calm	0.0	2.67	......	...
	9 p. m.	Calm	0.0	2.68	29.568	54
10	3 a. m.	Calm	0.0	2.58	......	...
	7 a. m.	......	...	......	29.526	51
	9 a. m.	N.NW	2.3	2.58	......	...
	2 p. m.	......	...	......	29.559	48
	3 p. m.	N.NW	1.3	2.50	......	...
	9 p. m.	N.NW	0.2	2.52	29.626	43
11	3 a. m.	Calm	0.0	2.54	......	...
	7 a. m.	......	...	......	29.686	38
	9 a. m.	N.NE	0.2	2.62	......	...
	2 p. m.	......	...	......	29.629	49
	3 p. m.	E.SE	0.3	2.63	......	...
	9 p. m.	Calm	0.0	2.71	29.566	41
	3 a. m.	Calm	0.0	2.69	......	...
	7 a. m.	......	...	......	29.475	38
	9 a. m.	S.SW	1.0	2.73	......	...
	2 p. m.	......	...	......	29.353	57
	3 p. m.	S.SE	1.9	2.72	......	...
	9 p. m.	Calm	0.0	2.72	29.316	45
13	3 a. m.	Calm	0.0	2.71	......	...
	7 a. m.	......	...	......	29.312	42
	9 a. m.	SW	1.0	2.70	......	...
	2 p. m.	......	...	......	29.283	63
	3 p. m.	SW	1.0	2.58	......	...
	9 p. m.	N.NE	4.6	2.46	29.426	51
14	3 a. m.	N.NE	2.9	2.55	......	...
	7 a. m.	......	...	......	29.587	40
	9 a. m.	N.NE	3.3	2.55	......	...
	2 p. m.	......	...	......	29.591	47
	3 p. m.	NE	2.2	2.52	......	...
	9 p. m.	NE	1.8	2.52	29.648	45
15	3 a. m.	NW	0.6	2.51	......	...
	7 a. m.	......	...	......	29.642	39
	9 a. m.	North	0.3	2.54	......	...
	2 p. m.	......	...	......	29.497	50
	3 p. m.	W.SW	0.5	2.54	......	...
	9 p. m.	SW	0.6	2.66	29.338	45
16	3 a. m.	SW	1.9	2.80	......	...
	7 a. m.	......	...	......	29.118	46
	9 a. m.	NW	0.3	2.70	......	...
	2 p. m.	......	...	......	29.117	58
	3 p. m.	N.NW	3.5	2.71	......	...
	9 p. m.	N.NW	0.7	2.65	29.374	44
17	3 a. m.	N.NW	0.3	2.74	......	...
	7 a. m.	......	...	......	29.555	36
	9 a. m.	NE	0.8	2.71	......	...
	2 p. m.	......	...	......	29.556	50
	3 p. m.	S.SE	1.5	2.72	......	...
	9 p. m.	S.SW	0.8	2.74	29.523	44
18	3 a. m.	S.SW	1.6	2.85	......	...
	7 a. m.	......	...	......	29.444	49
	9 a. m.	SW	3.9	3.01	......	...
	2 p. m.	......	...	......	29.268	70
	3 p. m.	SW	3.4	3.00	......	...
	9 p. m.	NW	2.9	2.86	29.398	63
19	3 a. m.	W.NW	2.2	3.03	......	...
	7 a. m.	......	...	......	29.509	43
	9 a. m.	N.NW	3.3	2.92	......	...
	2 p. m.	......	...	......	29.616	51
	3 p. m.	N.NW	2.1	3.04	......	...
	9 p. m.	Calm	0.0	2.94	29.647	39
20	3 a. m.	Calm	0.0	2.96	......	...
	7 a. m.	......	...	......	29.457	40
	9 a. m.	S.SW	3.6	2.96	......	...
	2 p. m.	......	...	......	29.120	56
	3 p. m.	S.SW	4.3	3.13	......	...
	9 p. m.	SW	4.6	2.94	28.945	55

Date.	Hour of day.	WIND.		Height of water below 1838.	Barometer reduced to 32°.	Therm'r detached.
		Course.	Relative velocity.			
1862.						
Oct. 21	3 a. m.	W.NW	2.0	2.89	......	...
	7 a. m.	......	...	......	28.981	49
	9 a. m.	W.NW	3.2	2.96	......	...
	2 p. m.	......	...	......	28.979	60
	3 p. m.	W.NW	4.9	3.05	......	...
	9 p. m.	NW	3.4	2.95	29.139	46
22	3 a. m.	W.NW	1.8	3.05	......	...
	7 a. m.	......	...	......	29.369	37
	9 a. m.	NW	3.9	3.15	......	...
	2 p. m.	......	...	......	29.419	46
	3 p. m.	NW	3.0	3.10	......	...
	9 p. m.	N.NW	0.2	3.04	29.583	35
23	3 a. m.	Calm	0.0	3.03	......	...
	7 a. m.	......	...	......	29.699	36
	9 a. m.	NE	0.7	2.90	......	...
	2 p. m.	......	...	......	29.501	49
	3 p. m.	S.SE	2.8	2.81	......	...
	9 p. m.	S.SW	2.3	2.83	29.341	46
24	3 a. m.	W.SW	2.4	2.71	......	...
	7 a. m.	......	...	......	20.294	47
	9 a. m.	W.NW	3.7	2.71	......	...
	2 p. m.	......	...	......	29.514	39
	3 p. m.	W.NW	3.9	2.88	......	...
	9 p. m.	NW	3.6	2.93	29.734	32
25	3 a. m.	N.NW	3.0	2.96	......	...
	7 a. m.	......	...	......	29.945	26
	9 a. m.	North	3.2	2.87	......	...
	2 p. m.	......	...	......	29.937	36
	3 p. m.	N.NE	2.2	2.79	......	...
	9 p. m.	N.NW	0.6	2.77	29.904	28
26	3 a. m.	Calm	0.0	2.75	......	...
	7 a. m.	......	...	......	29.673	27
	9 a. m.	W.SW	1.8	2.84	......	...
	2 p. m.	......	...	......	29.491	39
	3 p. m.	SW	2.2	2.91	......	...
	9 p. m.	Calm	0.0	2.94	29.411	32
27	3 a. m.	Calm	0.0	2.92	......	...
	7 a. m.	......	...	......	29.352	29
	9 a. m.	S.SW	0.2	2.87	......	...
	2 p. m.	......	...	......	29.264	43
	3 p. m.	S.SE	1.0	2.73	......	...
	9 p. m.	S.SW	1.6	2.69	29.198	45
28	3 a. m.	S.SW	1.5	2.69	......	...
	7 a. m.	......	...	......	29.143	40
	9 a. m.	W.NW	2.6	2.71	......	...
	2 p. m.	......	...	......	29.194	50
	3 p. m.	W.NW	2.6	2.63	......	...
	9 p. m.	NW	0.7	2.61	29.371	42
29	3 a. m.	W.NW	0.4	2.65	......	...
	7 a. m.	......	...	......	29.512	34
	9 a. m.	S.SW	0.4	2.74	......	...
	2 p. m.	......	...	......	29.480	51
	3 p. m.	NE	0.5	2.86	......	...
	9 p. m.	SW	2.8	2.91	29.414	54
30	3 a. m.	......	...	2.97	......	...
	7 a. m.	......	...	......	29.287	53
	9 a. m.	W.SW	3.4	2.83	......	...
	2 p. m.	......	...	......	29.224	68
	3 p. m.	W.SW	2.0	2.83	......	...
	9 p. m.	SW	0.6	2.76	29.241	52
31	3 a. m.	SW	2.9	2.92	......	...
	7 a. m.	......	...	......	29.179	55
	9 a. m.	SW	4.6	2.89	......	...
	2 p. m.	......	...	......	29.140	71
	3 p. m.	W.SW	2.6	2.83	......	...
	9 p. m.	N.NE	2.5	2.67	29.243	53
Nov. 1	3 a. m.	NE	2.3	2.49	......	...
	7 a. m.	......	...	......	29.286	45
	9 a. m.	NE	1.7	2.60	......	...
	2 p. m.	......	...	......	29.268	45
	3 p. m.	N.NE	2.6	2.72	......	...
	9 p. m.	N.NW	1.7	2.70	29.394	39

TABLE AA.—*Showing the wind, water, barometer, &c.*—Continued.

Date.	Hour of day.	WIND.		Height of water below 1838.	Barometer reduced to 32°.	Therm'r detached.	Date.	Hour of day.	WIND.		Height of water below 1838.	Barometer reduced to 32°.	Therm'r detached.
		Course.	Relative velocity.						Course.	Relative velocity.			
1862. Nov. 2	3 a. m.	N.NW..	1.1	2.75	......	...	1862. Nov. 14	3 a. m.	Calm...	0.0	2.98	......	...
	7 a. m.	......	....	......	29.330	35		7 a. m.	......	....	......	29.778	29
	9 a. m.	NW....	1.1	2.82	......	...		9 a. m.	N.NW.	1.0	3.06	......	...
	2 p. m.	......	....	......	29.275	38		2 p. m.	......	....	......	29.827	29
	3 p. m.	W.NW.	2.0	2.94	......	...		3 p. m.	N.NW..	0.6	3.04	......	...
	9 p. m.	W.NW.	2.2	3.04	29.298	36		9 p. m.	North..	0.1	3.07	29.949	25
3	3 a. m.	West..	0.4	3.08	......	...	15	3 a. m.	E.NE..	0.3	3.03	......	...
	7 a. m.	......	....	......	29.394	32		7 a. m.	......	....	......	30.034	29
	9 a. m.	N.NE..	2.6	2.99	......	...		9 a. m.	SE.....	0.6	2.96	......	...
	2 p. m.	......	....	......	29.521	41		2 p. m.	......	....	......	29.955	36
	3 p. m.	N.NE..	1.7	3.08	......	...		3 p. m.	E.SE...	0.5	......	......	...
	9 p. m.	E.SE...	0.6	3.00	29.506	40		9 p. m.	SE.....	1.7	......	29.922	38
4	3 a. m.	Calm...	0.0	2.97	......	...	16	3 a. m.	SE.....	007	......	......	...
	7 a. m.	......	....	......	29.382	36		7 a. m.	......	....	......	29.803	38
	9 a. m.	S.SW..	1.5	2.99	......	...		9 a. m.	......	....	2.64	......	...
	2 p. m.	......	....	......	29.254	55		2 p. m.	......	....	......	29.715	40
	3 p. m.	S.SW..	2.1	2.94	......	...		3 p. m.	Calm...	0.0	2.70	......	...
	9 p. m.	SW....	1.8	2.82	29.276	48		9 p. m.	Calm...	0.0	2.70	29.672	40
5	3 a. m.	......	....	2.77	......	...	17	3 a. m.	Calm...	0.0	2.86	......	...
	7 a. m.	......	....	......	29.454	38		7 a. m.	......	....	......	29.774	42
	9 a. m.	North..	3.9	2.82	......	...		9 a. m.	Calm...	0.0	2.92	......	...
	2 p. m.	......	....	......	29.560	42		2 p. m.	......	....	......	29.752	44
	3 p. m.	N.NW..	3.2	2.93	......	...		3 p. m.	Calm...	0.0	2.97	......	...
	9 p. m.	Calm...	0.0	2.99	29.682	32		9 p. m.	Calm...	0.0	2.93	29.772	38
	3 a. m.	Calm...	0.0	3.09	......	...	18	3 a. m.	Calm...	0.0	2.96	......	...
	7 a. m.	......	....	......	29.474	26		7 a. m.	......	....	......	29.611	37
	9 a. m.	SW....	0.6	3.16	......	...		9 a. m.	Calm...	0.0	2.89	......	...
	2 p. m.	......	....	......	29.133	35		2 p. m.	......	....	......	29.536	45
	3 p. m.	SW....	0.7	3.05	......	...		3 p. m.	Calm...	0.0	2.94	......	...
	9 p. m.	North..	0.2	2.77	29.224	32		9 p. m.	Calm...	0.0	2.90	29.411	43
7	3 a. m.	E.NE..	1.8	2.56	......	...	19	3 a. m.	N.NE..	1.3	2.93	......	...
	7 a. m.	......	....	......	29.500	37		7 a. m.	......	....	......	29.374	39
	9 a. m.	E.NE...	2.5	2.64	......	...		9 a. m.	N.NE..	2.5	2.86	......	...
	2 p. m.	......	....	......	29.586	39		2 p. m.	......	....	......	29.336	39
	3 p. m.	NE....	2.1	2.70	......	...		3 p. m.	N.NE..	1.8	2.95	......	...
	9 p. m.	Calm...	0.0	2.77	29.594	31		9 p. m.	N.NW..	0.7	2.86	29.271	33
8	3 a. m.	Calm...	0.0	2.85	......	...	20	3 a. m.	NW....	1.5	2.88	......	...
	7 a. m.	......	....	......	29.595	27		7 a. m.	......	....	......	29.222	30
	9 a. m.	N.NW..	0.1	2.97	......	...		9 a. m.	N.NE...	3.2	2.67	......	...
	2 p. m.	......	....	......	29.541	41		2 p. m.	......	....	......	29.31.	37
	3 p. m.	SE.....	0.2	2.98	......	...		3 p. m.	N.NE...	2.1	2.77	......	...
	9 p. m.	Calm...	0.0	3.10	29.558	33		9 p. m.	N.NW..	0.7	2.75	29.408	29
9	3 a. m.	Calm...	0.0	3.06	......	...	21	3 a. m.	......	....	2.84	......	...
	7 a. m.	......	....	......	29.625	34		7 a. m.	......	....	......	29.354	25
	9 a. m.	W.NW.	0.4	3.04	......	...		9 a. m.	W.SW.	1.5	2.96	......	...
	2 p. m.	......	....	......	29.631	46		2 p. m.	......	....	......	29.222	42
	3 p. m.	E.NE..	0.5	2.96	......	...		3 p. m.	W.SW..	1.4	3.03	......	...
	9 p. m.	Calm...	0.0	2.98	29.661	35		9 p. m.	West...	0.6	3.02	39.246	37
10	3 a. m.	Calm...	0.0	2.99	......	...	22	3 a. m.	N.NW..	1.6	2.95	......	...
	7 a. m.	......	....	......	29.592	30		7 a. m.	......	....	......	29.408	34
	9 a. m.	E.SE..	0.2	3.01	......	...		9 a. m.	North...	3.0	2.87	......	...
	2 p. m.	......	....	......	39.421	46		2 p. m.	......	....	......	29.522	39
	3 p. m.	SE.....	0.6	2.97	......	...		3 p. m.	N.NW..	2.1	2.78	......	...
	9 p. m.	SW....	2.4	3.00	29.263	50		9 p. m.	N.NE..	1.4	2.87	29.652	31
11	3 a. m.	SW....	3.3	3.02	......	...	23	3 a. m.	N.NW..	0.9	2.88	......	...
	7 a. m.	......	....	......	29.101	49		7 a. m.	......	....	......	29.794	21
	9 a. m.	W.SW.	2.5	2.94	......	...		9 a. m.	N.NW..	1.2	2.97	......	...
	2 p. m.	......	....	......	29.065	45		2 p. m.	......	....	......	29.614	35
	3 p. m.	NW....	2.1	2.94	......	...		3 p. m.	W SW.	1.3	3.07	......	...
	9 p. m.	W.NW.	0.9	3.04	29.341	34		9 p. m.	W.SW..	1.4	3.26	29.463	32
12	3 a. m.	W.NW.	0.1	3.16	......	...	24	3 a. m.	W.SW.	7.8	......	......	...
	7 a. m.	......	....	......	29.542	25		7 a. m.	......	....	......	29.227	32
	9 a. m.	W.SW.	0.7	3.24	......	...		9 a. m.	SW....	3.5	......	......	...
	2 p. m.	......	....	......	29.484	35		2 p. m.	......	....	......	29.125	42
	3 p. m.	West...	0.9	3.21	......	...		3 p. m.	W.SW.	2.4	......	......	...
	9 p. m.	W.SW.	0.1	3.25	29.535	32		9 p. m.	W.NW.	1.4	......	29.194	39
13	3 a. m.	W.NW.	0.1	3.25	......	...	25	3 a. m.	W.NW.	1.4	......	......	...
	7 a. m.	......	....	......	29.600	26		7 a. m.	......	....	......	29.277	34
	9 a. m.	SW....	0.4	3.29	......	...		9 a. m.	N.NW..	2.3	......	......	...
	2 p. m.	......	....	......	29.523	38		2 p. m.	......	....	......	29.325	32
	3 p. m.	S.SW..	0.1	3.15	......	...		3 p. m.	N.NW..	2.2	......	......	...
	9 p. m.	Calm...	0.0	3.06	29.486	38		9 p. m.	N.NW..	1.8	......	29.426	30

TABLE AA.—*Showing the wind, water, barometer, &c.*—Continued.

Date.	Hour of day.	WIND.		Height of water below 1828.	Barometer reduced to 32°.	Therm'r detached.	Date.	Hour of day.	WIND.		Height of water below 1838.	Barometer reduced to 32°.	Therm'r detached.
		Course.	Relative velocity.						Course.	Relative velocity.			
1862. Nov. 26	3 a. m.	NW	2.0	......	......	......	1862. Dec. 8	3 a. m.	SW	0.9	3.21	......	......
	7 a. m.	......	......	......	29.453	27		7 a. m.	......	......	......	29.303	17
	9 a. m.	W. NW.	2.5	......	......	......		9 a. m.	NW	1.6	......	......	......
	2 p. m.	......	......	......	29.346	34		2 p. m.	......	......	......	29.381	29
	3 p. m.	W. SW	1.8	......	......	......		3 p. m.	W. NW.	1.2	3.19	......	......
	9 p. m.	S. SW	2.1	......	29.238	30		9 p. m.	N. NW	0.3	3.14	29.542	21
27	3 a. m.	S. SW	1.5	......	......	......	9	3 a. m.	N. NW	0.2	3.20	......	......
	7 a. m.	......	......	......	28.969	30		7 a. m.	......	......	......	29.645	17
	9 a. m.	SW	0.7	3.17	......	......		9 a. m.	West	1.3	3.36	......	......
	2 p. m.	......	......	......	28.933	32		2 p. m.	......	......	......	29.549	33
	3 p. m.	NW	1.5	3.04	......	......		3 p. m.	W. SW	1.4	3.44	......	......
	9 p. m.	NW	2.0	3.00	29.001	31		9 p. m.	SW	0.5	3.59	29.502	28
28	3 a. m.	W. NW.	2.4	2.98	......	......	10	3 a. m.	W. SW	1.5	3.54	......	......
	7 a. m.	......	......	......	28.946	26		7 a. m.	......	......	......	29.388	33
	9 a. m.	W. NW.	1.8	2.97	......	......		9 a. m.	W. SW	2.8	3.59	......	......
	2 p. m.	......	......	......	28.910	29		2 p. m.	......	......	......	29.287	46
	3 p. m.	W. NW.	0.8	3.03	......	......		3 p. m.	SW	2.5	3.55	......	......
	9 p. m.	NW	0.1	3.07	28.985	25		9 p. m.	SW	3.2	3.56	29.256	44
29	3 a. m.	NW	0.7	3.06	......	......	11	3 a. m.	SW	2.9	3.51	......	......
	7 a. m.	......	......	......	29.072	27		7 a. m.	......	......	......	29.237	42
	9 a. m.	NW	0.7	3.07	......	......		9 a. m.	W. SW	3.5	3.61	......	......
	2 p. m.	......	......	......	29.113	35		2 p. m.	......	......	......	29.218	48
	3 p. m.	SW	0.6	3.04	......	......		3 p. m.	West	2.6	3.57	......	......
	9 p. m.	S. SW	0.5	3.05	29.156	30		9 p. m.	W. NW.	0.6	3.45	29.381	41
30	3 a. m.	S. SW	0.2	3.01	......	......	12	3 a. m.	E. NE	0.2	3.36	......	......
	7 a. m.	......	......	......	29.134	30		7 a. m.	......	......	......	29.394	40
	9 a. m.	N. NE	1.3	2.91	......	......		9 a. m.	SE	0.7	3.28	......	......
	2 p. m.	......	......	......	29.199	33		2 p. m.	......	......	......	29.228	40
	3 p. m.	N. NW	1.5	3.00	......	......		3 p. m.	SE	0.3	3.15	......	......
	9 p. m.	NW	1.3	2.97	29.231	30		9 p. m.	S. SE	1.8	3.06	29.196	43
Dec. 1	3 a. m.	N. NW	1.8	2.98	......	......	13	3 a. m.	S. SW	1.8	3.01	......	......
	7 a. m.	......	......	......	29.574	28		7 a. m.	......	......	......	39.111	48
	9 a. m.	N. NW	2.4	2.97	......	......		9 a. m.	S. SW	3.0	3.12	......	......
	2 p. m.	......	......	......	29.662	28		2 p. m.	......	......	......	29.092	55
	3 p. m.	NW	1.7	3.06	......	......		3 p. m.	W. SW	4.0	3.23	......	......
	9 p. m.	W. NW.	1.5	3.10	......	25		9 p. m.	W. NW.	1.4	3.20	29.236	42
2	3 a. m.	W. NW.	1.3	3.23	......	......	14	3 a. m.	W. NW.	0.1	3.29	......	......
	7 a. m.	......	......	......	29.729	18		7 a. m.	......	......	......	26.260	39
	9 a. m.	W. SW	1.7	3.31	......	......		9 a. m.	S. SE	0.3	3.34	......	......
	2 p. m.	......	......	......	29.594	24		2 p. m.	......	......	......	29.063	43
	3 p. m.	SW	1.5	3.34	......	......		3 p. m.	SW	1.2	3.34	......	......
	9 p. m.	SW	1.6	3.33	29.447	20		9 p. m.	W. NW.	3.5	3.39	29.080	42
3	3 a. m.	W. SW	1.9	3.34	......	......	15	3 a. m.	W. NW.	2.0	3.33	......	......
	7 a. m.	......	......	......	29.315	25		7 a. m.	......	......	......	29.163	33
	9 a. m.	W. NW.	1.5	3.28	......	......		9 a. m.	W. NW.	1.6	3.40	......	......
	2 p. m.	......	......	......	29.394	24		2 p. m.	......	......	......	29.111	33
	3 p. m.	W. NW.	1.4	3.27	......	......		3 p. m.	W. NW.	1.3	6.48	......	......
	9 p. m.	W. NW.	1.0	3.18	29.423	22		9 p. m.	W. SW	1.4	3.46	29.095	33
4	3 a. m.	W. SW	0.8	3.17	......	......	16	3 a. m.	W. NW.	3.2	3.48	......	......
	7 a. m.	......	......	......	29.378	20		7 a. m.	......	......	......	29.123	48
	9 a. m.	SW	0.3	......	......	......		9 a. m.	NW	3.5	3.39	......	......
	2 p. m.	......	......	......	29.262	26		2 p. m.	......	......	......	29.297	31
	3 p. m.	NW	1.5	......	......	......		3 p. m.	W. NW.	3.5	3.45	......	......
	9 p. m.	W. NW.	0.5	......	29.344	21		9 p. m.	NW	3.7	3.34	29.496	24
5	3 a. m.	W. NW.	0.5	......	......	......	17	3 a. m.	N. NW	2.6	3.37	......	......
	7 a. m.	......	......	......	29.320	18		7 a. m.	......	......	......	29.812	17
	9 a. m.	SW	1.2	......	......	......		9 a. m.	N. NW	2.2	3.28	......	......
	2 p. m.	......	......	......	29.174	26		2 p. m.	......	......	......	29.895	25
	3 p. m.	W. NW.	2.9	......	......	......		3 p. m.	SW	0.5	3.31	......	......
	9 p. m.	N. NW	3.2	......	29.282	20		9 p. m.	S. SW	2.4	3.36	29.882	25
6	3 a. m.	N. NW	3.4	......	......	......	18	3 a. m.	SW	2.8	3.36	......	......
	7 a. m.	......	......	......	29.536	4		7 a. m.	......	......	......	29.605	27
	9 a. m.	N. NW	3.4	......	......	......		9 a. m.	SW	4.0	3.81	......	......
	2 p. m.	......	......	......	29.607	10		2 p. m.	......	......	......	29.362	42
	3 p. m.	NW	2.6	......	......	......		3 p. m.	SW	3.5	3.80	......	......
	9 p. m.	NW	1.3	3.22	29.657	6		9 p. m.	W. NW.	1.3	3.67	29.509	38
7	3 a. m.	W. NW.	0.8	3.25	......	......	19	3 a. m.	N. NE	2.3	3.33	......	......
	7 a. m.	......	......	......	29.664	1		7 a. m.	......	......	......	29.800	29
	9 a. m.	W. NW.	0.8	......	......	......		9 a. m.	N. NE	6.0	3.52	......	......
	2 p. m.	......	......	......	29.626	16		2 p. m.	......	......	......	29.937	25
	3 p. m.	W. SW	0.9	3.24	......	......		3 p. m.	N. NE	3.9	3.40	......	......
	9 p. m.	SW	1.0	3.23	29.549	8		9 p. m.	N. NE	1.9	3.24	30.020	2

TABLE AA.—*Showing the wind, water, barometer, &c.*—Continued.

Date.	Hour of day.	Wind.		Height of water below 1838.	Barometer reduced to 32°.	Therm'r detached.	Date.	Hour of day.	Wind.		Height of water below 1838.	Barometer reduced to 32°.	Therm'r detached.
		Course.	Relative velocity.						Course.	Relative velocity.			
1862. Dec. 20	3 a. m.	E. SE	1.6	3.15			1863. Jan. 1	3 a. m.	SW	2.3	3.87		
	7 a. m.				30.032	24		7 a. m.				29.508	29
	9 a. m.	S. SE	1.3	3.22				9 a. m.	S. SW	2.9	3.93		
	2 p. m.				29.970	28		2 p. m.				29.361	41
	3 p. m.	S. SE	2.6	3.22				3 p. m.	S. SW	3.5	3.87		
	9 p. m.	S. SW	1.8	3.38	29.805	26		9 p. m.	S. SW	4.3	3.96	29.248	37
21	3 a. m.	South	1.8	3.45			2	3 a. m.	S. SW	3.7	3.65		
	7 a. m.				29.571	29		7 a. m.				29.152	38
	9 a. m.	S. SW	2.3	3.50				9 a. m.	S. SW	3.0	3.65		
	2 p. m.				29.471	28		2 p. m.				28.945	41
	3 p. m.	W. NW	1.2	3.36				3 p. m.	S. SW	4.6	3.64		
	9 p. m.	Calm	0.0	3.44	29.513	29		9 p. m.	S. SW	3.2	3.54	29.031	47
22	3 a. m.	W. SW	1.0	3.42			3	3 a. m.	S. SW	1.7	3.44		
	7 a. m.				29.439	36		7 a. m.				29.053	46
	9 a. m.	W. NW	2.6	3.57				9 a. m.	S. SE	0.6	3.43		
	2 p. m.				29.371	40		2 p. m.				29.013	44
	3 p. m.	W. NW	2.6	3.44				3 p. m.	SE	0.2	3.36		
	9 p. m.	N. NE	1.1	3.45	29.499	85		9 p. m.	Calm	0.0	3.29	28.897	46
23	3 a. m.	NE	0.7	3.31			4	3 a. m.	N. NW	2.2	3.28		
	7 a. m.				29.596	36		7 a. m.				28.808	39
	9 a. m.	East	1.5	3.38				9 a. m.	W. NW	3.8	3.24		
	2 p. m.				29.532	36		2 p. m.				28.978	40
	3 p. m.	SE	2.2	3.23				3 p. m.	West	2.2	3.46		
	9 p. m.	S. SE	2.7	3.18	29.396	37		9 p. m.	SW	2.0	3.51	28.955	39
24	3 a. m.	South	1.7	3.16			5	3 a. m.	W. SW	1.5	3.58		
	7 a. m.				29.209	43		7 a. m.				28.998	36
	9 a. m.	W. SW	3.1	3.30				9 a. m.	W. SW	0.3	3.51		
	2 p. m.				29.249	50		2 p. m.				28.985	37
	3 p. m.	SW	3.6	3.21				3 p. m.	NW	0.1	3.49		
	9 p. m.	West	3.0	3.49	29.318	45		9 p. m.			3.51	29.072	31
25	3 a. m.	W. NW	0.8	3.41			6	3 a. m.			3.46		
	7 a. m.				29.347	36		7 a. m.				29.197	11
	9 a. m.	West	0.1	3.60				9 a. m.	NW	3.7	3.55		
	2 p. m.				29.229	41		2 p. m.				29.334	11
	3 p. m.	Calm	0.0	3.56				3 p. m.	NW	3.0	3.58		
	9 p. m.	E. NE	0.3	3.48	29.161	37		9 p. m.	W. NW	1.4	3.67	29.471	9
26	3 a. m.	NE	1.7	3.27			7	3 a. m.	W. NW	1.2			
	7 a. m.				28.911	41		7 a. m.				29.626	5
	9 a. m.	N. NE	3.3	3.17				9 a. m.	W. NW	1.4			
	2 p. m.				28.953	43		2 p. m.				29.632	17
	3 p. m.	N. NW	3.4	3.14				3 p. m.	West	0.5			
	9 p. m.	W. NW	0.4	3.23	29.166	36		9 p. m.	SW	0.1		29.618	17
27	3 a. m.	W. NW	0.8	3.20			8	3 a. m.	Calm	0.0			
	7 a. m.				29.217	30		7 a. m.				29.578	21
	9 a. m.	NW	1.5	3.35				9 a. m.	Calm	0.0			
	2 p. m.				29.203	31		2 p. m.				29.559	26
	3 p. m.	W. NW	2.4	3.43				3 p. m.	NW	0.1			
	9 p. m.	West	1.5	3.44	29.213	29		9 p. m.	Calm	0.0		29.626	17
28	3 a. m.	SW	1.1	3.46			9	3 a. m.	Calm	0.0	3.46		
	7 a. m.				29.181	31		7 a. m.				29.595	14
	9 a. m.	S. SW	0.8	3.53				9 a. m.	South	0.3	3.37		
	2 p. m.				28.996	44		2 p. m.				29.452	35
	3 p. m.	SW	2.4	3.54				3 p. m.	S. SE	1.0	3.33		
	9 p. m.	W. NW	1.9	3.46	29.000	39		9 p. m.	S. SE	1.1	3.43	29.229	36
29	3 a. m.	N. NW	0.9	3.41			10	3 a. m.	SW	0.4	3.35		
	7 a. m.				29.349	35		7 a. m.				28.973	35
	9 a. m.	North	1.4	3.44				9 a. m.	W. NW	1.9	3.46		
	2 p. m.				29.506	36		2 p. m.				28.988	29
	3 p. m.	N. NE	0.6	3.44				3 p. m.	W. NW	2.6	3.45		
	9 p. m.	N. NE	2.2	3.38	29.436	33		9 p. m.	W. NW	0.2	3.46	29.073	24
30	3 a. m.	N. NE	4.3	3.31			11	3 a. m.	Calm	0.0	3.51		
	7 a. m.				29.462	28		7 a. m.				29.155	19
	9 a. m.	N. NE	3.5	3.27				9 a. m.	NW	0.2	3.66		
	2 p. m.				29.457	29		2 p. m.				29.289	25
	3 p. m.	N. NE	2.3	3.29				3 p. m.	N. NW	0.1	3.53		
	9 p. m.	N. NW	0.4	3.29	29.574	23		9 p. m.	Calm	0.0	3.49	29.409	22
31	3 a. m.	W. NW	0.1	3.34			12	3 a. m.	Calm	0.0	3.45		
	7 a. m.				29.609	21		7 a. m.				29.362	24
	9 a. m.	SW	1.6	3.44				9 a. m.	Calm	0.0	3.40		
	2 p. m.				29.604	36		2 p. m.				29.416	37
	3 p. m.	S. SW	2.8	3.60				3 p. m.	NE	0.7	3.34		
	9 p. m.	S. SW	3.4	3.82	29.594	31		9 p. m.	E. NE	1.0	3.40	29.571	34

TABLE AA.—*Showing the wind, water, barometer, &c.*—Continued.

Date.	Hour of day.	WIND.		Height of water below 1838.	Barometer reduced to 32°.	Therm'r detached.
		Course.	Relative velocity.			
1863. Jan. 13	3 a. m.	East....	1.7	3.30	....	...
	7 a. m.	....	...	......	29.354	35
	9 a. m.	SE	2.4	3.30	....	...
	2 p. m.	....	...	......	29.048	40
	3 p. m.	S.SW ..	0.3	3.19	....	...
	9 p. m.	W.NW	3.2	3.29	29.022	45
14	3 a. m.	W.NW.	3.4	3.31	....	...
	7 a. m.	....	...	....	29.220	27
	9 a. m.	W.NW.	2.9	3.53	....	...
	2 p. m.	....	...	......	29.161	25
	3 p. m.	W.NW.	2.1	3.54	....	...
	9 p. m.	N.NW..	0.7	3.53	29.271	19
15	3 a. m.	N.NW..	0.4	3.71	....	...
	7 a. m.	....	...	......	29.245	16
	9 a. m.	N.NW..	1.3	3.58	....	...
	2 p. m.	....	...	......	29.143	20
	3 p. m.	....	...	3.34	....	...
	9 p. m.	N.NE ..	4.3	......	29.189	18
16	3 a. m.	North ..	3.7	......	....	...
	7 a. m.	....	...	......	29.236	10
	9 a. m.	N.NW..	2.0	......	....	...
	2 p. m.	....	...	......	29.394	14
	3 p. m.	NW....	0.8	......	....	...
	9 p. m.	Calm...	0.0	......	29.479	10
17	3 a. m.	Calm...	0.0	......	....	...
	7 a. m.	....	...	......	29.640	11
	9 a. m.	S.SW ..	0.6	......	....	...
	2 p. m.	....	...	......	29.678	24
	3 p. m.	S.SW ..	1.5	......	....	...
	9 p. m.	S.SW ..	1.3	......	29.725	18
18	3 a. m.	S.SW ..	0.9	......	....	...
	7 a. m.	....	...	......	29.704	17
	9 a. m.	S.SW ..	1.7	......	....	...
	2 p. m.	....	...	......	29.657	37
	3 p. m.	S.SW ..	0.8	......	....	...
	9 p. m.	S.SW ..	0.3	......	29.692	31
19	3 a. m.	Calm...	0.0	......	....	...
	7 a. m.	....	...	......	29.706	28
	9 a. m.	Calm...	0.0	......	....	...
	2 p. m.	....	...	......	29.656	36
	3 p. m.	Calm...	0.0	......	....	...
	9 p. m.	E.SE ..	0.3	......	29.617	34
20	3 a. m.	E.SE ..	0.8	......	....	...
	7 a. m.	....	...	......	29.407	36
	9 a. m.	E.SE ..	1.4	......	....	...
	2 p. m.	....	...	......	29.374	37
	3 p. m.	East. ..	0.1	......	....	...
	9 p. m.	Calm...	0.0	......	29.414	36
21	3 a. m.	N.NW..	0.1	......	....	...
	7 a. m.	....	...	......	29.518	33
	9 a. m.	North ..	0.1	3.22	....	...
	2 p. m.	....	...	......	29.569	34
	3 p. m.	W.SW .	0.1	3.29	....	...
	9 p. m.	S.SW ..	0.3	3.44	29.563	34
22	3 a. m.	S.SW ..	0.6	3.53	....	...
	7 a. m.	....	...	......	29.421	36
	9 a. m.	SW	0.7	3.70	....	...
	2 p. m.	....	...	......	29.394	38
	3 p. m.	Calm...	0.0	3.47	....	...
	9 p. m.	N.NE ..	0.1	3.54	29.421	37
23	3 a. m.	E.NE ..	0.9	3.46	....	...
	7 a. m.	....	...	......	29.422	35
	9 a. m.	E.NE ..	0.5	3.42	....	...
	2 p. m.	....	...	......	29.284	48
	3 p. m.	SE	2.5	3.07	....	...
	9 p. m.	S.SE ...	2.7	3.18	29.162	38
24	3 a. m.	SW	2.5	......	....	...
	7 a. m.	....	...	......	29 237	35
	9 a. m.	W.SW .	2.5	......	....	...
	2 p. m.	....	...	......	29.362	36
	3 p. m.	West...	2.1	......	....	...
	9 p. m.	West...	0.5	......	29.515	33
1863. Jan. 25	3 a. m.	Calm...	0.0	......	....	...
	7 a. m.	....	...	......	29.595	29
	9 a. m.	S.S W..	0.1	......	....	...
	2 p. m.	....	...	......	29.552	41
	3 p. m.	South ..	0.1	......	....	...
	9 p. m.	Calm...	0.0	......	29.558	36
26	3 a. m.	Calm...	0.0	......	....	...
	7 a. m.	....	...	......	29.484	35
	9 a. m.	N.NW..	0.7	......	....	...
	2 p. m.	....	...	......	29.424	36
	3 p. m.	N.NW..	0.7	......	....	...
	9 p. m.	N.NW..	0.7	......	29.436	23
27	3 a. m.	N.NE ..	0.9	......	....	...
	7 a. m.	....	...	......	24.472	29
	9 a. m.	N.NW..	1.0	......	....	...
	2 p. m.	....	...	......	29.467	29
	3 p. m.	North ..	0.8	......	....	...
	9 p. m.	North ..	0.2	......	29.612	28
28	3 a. m.	NW	0.1	......	....	...
	7 a. m.	....	0.1	......	29.484	19
	9 a. m.	W.SW .	0.2	......	....	...
	2 p. m.	....	...	......	29.354	32
	3 p. m.	W.SW .	0.5	......	....	...
	9 p. m.	W.SW .	0.3	......	29.251	29
29	3 a. m.	W.SW .	0.4	......	....	...
	7 a. m.	....	...	......	29.039	28
	9 a. m.	W.NW.	0.5	......	....	...
	2 p. m.	....	...	......	28.928	40
	3 p. m.	West ...	1.5	......	....	...
	9 p. m.	W.NW.	0.8	......	29.016	31
30	3 a. m.	N.NW..	...	......	....	...
	7 a. m.	....	...	......	29.288	29
	9 a. m.	NW	1.7	......	....	...
	2 p. m.	....	...	......	29.396	31
	3 p. m.	W.NW.	1.0	......	....	...
	9 p. m.	West...	0.6	......	29.314	29
31	3 a. m.	SW	0.2	......	....	...
	7 a. m.	....	...	......	29.305	26
	9 a. m.	W.NW.	1.0	......	....	...
	2 p. m.	....	...	......	29.264	33
	3 p. m.	North ..	0.1	......	....	...
	9 p. m.	Calm...	0.0	......	29.231	32
Feb. 1	3 a. m.	S.SW ..	0.2	......	....	...
	7 a. m.	....	...	......	29.911	35
	9 a. m.	West...	3.4	......	....	...
	2 p. m.	....	...	......	28.988	19
	3 p. m.	W.NW.	5.8	......	....	...
	9 p. m.	W.NW.	4.0	......	29.371	8
2	3 a. m.	W.NW.	2.2	......	....	...
	7 a. m.	....	...	......	29.627	– 4
	9 a. m.	NW	2.3	......	....	...
	2 p. m.	....	...	......	29.659	2
	3 p. m.	NW	2.0	......	....	...
	9 p. m.	NW	1.0	......	29.697	– 2
3	3 a. m.	NW	1.3	......	....	...
	7 a. m.	....	...	......	29.805	–10
	9 a. m.	NW	0.7	......	....	...
	2 p. m.	....	...	......	29.832	3
	3 p. m.	N.NW..	0.1	......	....	...
	9 p. m.	Calm...	0.0	......	29.892	2
4	3 a. m.	Calm...	0.0	......	....	...
	7 a. m.	....	...	......	29.857	11
	9 a. m.	S.SW ..	0.3	......	....	...
	2 p. m.	....	...	......	29.753	21
	3 p. m.	S.SE....	1.4	......	....	...
	9 p. m.	S.SW ..	0.3	......	29.657	23
5	3 a. m.	Calm...	0.0	......	....	...
	7 a. m.	....	...	......	29.490	20
	9 a. m.	N.NW..	0.1	......	....	...
	2 p. m.	....	...	......	29.520	24
	3 p. m.	N.NW..	0.3	......	....	...
	9 p. m.	N.NW..	0.2	......	29.496	9

TABLE AA.—*Showing the wind, water, barometer, &c*—**Continued.**

Date.	Hour of day.	Wind.		Heig't of water above zero of tide-gauge.	Barometer reduced to 32°.	Therm'r detached.
		Course.	Relative velocity.			
1863. eb. 6	3 a. m.	NW	0.1			
	7 a. m.				29.488	17
	9 a. m.	West	0.1			
	2 p. m.				29.352	27
	3 p. m.	SW	0.3			
	9 p. m.	S.SW	0.5		39.332	25
7	3 a. m.	SW	0.5			
	7 a. m.				29.386	23
	9 a. m.	W.SW	0.8			
	2 p. m.				29.480	35
	3 p. m.	W.NW	0.2			
	9 p. m.	Calm	0.0		29.326	30
8	3 a. m.	N.NE	0.3			
	7 a. m.				29.738	25
	9 a. m.	NE	1.5			
	2 p. m.				29.697	30
	3 p. m.	NE	0.3			
	9 p. m.	E.NE	1.2		29.531	32
9	3 a. m.	E.SE	1.1			
	7 a. m.				29.405	32
	9 a. m.	SE	1.2			
	2 p. m.				29.083	39
	3 p. m.	W.NW	0.3			
	9 p. m.	W.NW	1.4		29.474	27
10	3 a. m.	W.NW	1.7			
	7 a. m.				29.695	19
	9 a. m.	W.NW	0.4			
	2 p. m.				29.733	26
	3 p. m.	Calm	0.0			
	9 p. m.	Calm	0.0		29.697	25
11	3 a. m.	Calm	0.0			
	7 a. m.				29.529	26
	9 a. m.	Calm	0.0			
	2 p. m.					
	3 p. m.	North	0.1			
	9 p. m.	N.NE	0.6		29.461	25
12	3 a. m.	Calm	0.0			
	7 a. m.				29.443	25
	9 a. m.	N.NE	2.3			
	2 p. m.				29.612	27
	3 p. m.	N.NE	1.6			
	9 p. m.	Calm	0.0		29.616	21
13	3 a. m.	Calm	0.0			
	7 a. m.				29.668	24
	9 a. m.	SE	0.1			
	2 p. m.				29.710	31
	3 p. m.	S.SE	1.2			
	9 p. m.	S.SE	2.2		29.472	34
14	3 a. m.	S.SE	2.9			
	7 a. m.				29.174	36
	9 a. m.	S.SE	2.7			
	2 p. m.				28.811	44
	3 p. m.	West	5.3			
	9 p. m.	West	6.0		29.118	31
15	3 a. m.	W.NW	3.1			
	7 a. m.				29.506	18
	9 a. m.	W.NW	1.9			
	2 p. m.				29.597	30
	3 p. m.	W.NW	1.0			
	9 p. m.	W.NW	0.1		29.752	26
16	3 a. m.	Calm	0.0			
	7 a. m.				29.861	13
	9 a. m.	Calm	0.0			
	2 p. m.				29.750	31
	3 p. m.	S.SE	0.3			
	9 p. m.	S.SE	0.1		29.642	33
17	3 a. m.	S.SE	0.2			
	7 a. m.				29.505	32
	9 a. m.	S.SE	0.2			
	2 p. m.				29.426	41
	3 p. m.	S.SE	0.1			
	9 p. m.	Calm	0.0		29.389	35
1863. Feb. 18	3 a. m.	Calm	0.0			
	7 a. m.				29.290	35
	9 a. m.	S.SW	0.1			
	2 p. m.				28.177	40
	3 p. m.	Calm	0.0			
	9 p. m.	Calm	0.6		29.169	35
19	3 a. m.	Calm	0.0			
	7 a. m.				29.086	35
	9 a. m.	N.NE	0.6			
	2 p. m.				28.943	37
	3 p. m.	N.NE	5.0			
	9 p. m.	N.NE	2.4		29.088	32
20	3 a. m.	North	0.3			
	7 a. m.				29.418	26
	9 a. m.	N.NE	0.2			
	2 p. m.				29.549	31
	3 p. m.	Calm	0.0			
	9 p. m.	NE	0.4		29.657	30
21	3 a. m.	N.NE	2.0			
	7 a. m.				29.838	23
	9 a. m.	E.NE	2.2			
	2 p. m.				29.812	24
	3 p. m.	E.NE	2.0			
	9 p. m.	E.NE	2.2		29.689	24
22	3 a. m.	E.NE	2.7			
	7 a. m.				29.545	23
	9 a. m.	NE	1.7			
	2 p. m.				29.605	26
	3 p. m.	NE	3.0			
	9 p. m.	Calm	0.0		29.688	23
23	3 a. m.	Calm	0.0			
	7 a. m.				29.702	18
	9 a. m.	SW	0.1			
	2 p. m.				29.606	32
	3 p. m.	S.SE	0.9			
	9 p. m.	Calm	0.0		29.525	28
24	3 a. m.	Calm	0.0			
	7 a. m.				29.515	27
	9 a. m.	Calm	0.0			
	2 p. m.				29.514	36
	3 p. m.	SW	0.1			
	9 p. m.	Calm	0.0		29.517	36
25	3 a. m.	N.NW	0.1			
	7 a. m.				29.491	33
	9 a. m.	Calm	0.0			
	2 p. m.				29.439	37
	3 p. m.	SE	0.2			
	9 p. m.	E.NE	0.3		29.238	36
26	3 a. m.	SE	0.3			
	7 a. m.				28.879	41
	9 a. m.	SW	2.1			
	2 p. m.				28.922	39
	3 p. m.	West	2.7			
	9 p. m.	West	0.4		29.143	37
27	3 a. m.	W.NW	0.7			
	7 a. m.				29.355	31
	9 a. m.	NW	0.2			
	2 p. m.				29.481	38
	3 p. m.	E.SE	0.2			
	9 p. m.	Calm	0.0		29.568	34
28	3 a. m.	Calm	0.0			
	7 a. m.				29.520	34
	9 a. m.	E.SE	0.1			
	2 p. m.				29.386	41
	3 p. m.	S.SE	0.1			
	9 p. m.	Calm	0.0		29.245	36
Mar. 1	3 a. m.	Calm	0.0			
	7 a. m.				29.151	35
	9 a. m.	W.NW	0.4			
	2 p. m.				29.205	39
	3 p. m.	W.NW	0.2			
	9 p. m.	Calm	0.0		29.241	36

TABLE AA.—*Showing the wind, water, barometer, &c.*—Continued.

Date.	Hour of day.	Wind.		Heig't of water above zero of tide-gauge.	Barometer reduced to 32°.	Therm'r detached.
		Course.	Relative velocity.			
1863. March 2	3 a. m.	E. SE	0.1			
	7 a. m.				29.096	34
	9 a. m.	E. NE	2.2			
	2 p. m.				29.098	33
	3 p. m.	N. NE	6.7			
	9 p. m.	N. NE	5.5		29.309	30
3	3 a. m.	N. NE	1.1			
	7 a. m.				29.525	11
	9 a. m.	North	0.2			
	2 p. m.				29.554	27
	3 p. m.	Calm	0.0			
	9 p. m.	Calm	0.0		29.516	21
4	3 a. m.	Calm	0.0			
	7 a. m.				29.782	12
	9 a. m.	North	0.1			
	2 p. m.				29.800	25
	3 p. m.	Calm	0.0			
	9 p. m.	Calm	0.0		29.740	17
5	3 a. m.	S. SW	0.8			
	7 a. m.				29.484	26
	9 a. m.	S. SW	2.2			
	2 p. m.				29.184	34
	3 p. m.	S. SW	2.9			
	9 p. m.	S. SW	2.5		28.972	37
6	3 a. m.	W.NW	2.4			
	7 a. m.				29.260	39
	9 a. m.	NW	1.6			
	2 p. m.				29.434	28
	3 p. m.	NW	0.5			
	9 p. m.	Calm	0.0		29.466	25
7	3 a. m.	Calm	0.0			
	7 a. m.				29.393	22
	9 a. m.	East	0.2			
	2 p. m.				29.309	32
	3 p. m.	Calm	0.0			
	9 p. m.	Calm	0.0		29.216	33
8	3 a. m.	S. SW	0.1			
	7 a. m.				29.078	33
	9 a. m.	W.NW	0.6			
	2 p. m.				29.068	36
	3 p. m.	W.NW	1.7			
	9 p. m.	W.NW	2.0		29.198	21
	3 a. m.	West	1.1			
	7 a. m.				29.365	18
	9 a. m.	W.NW	1.6			
	2 p. m.				29.464	25
	3 p. m.	W.NW	1.6			
	9 p. m.	Calm	0.0		29.477	22
10	3 a. m.	SW	0.1			
	7 a. m.				29.325	20
	9 a. m.	W. SW	1.1			
	2 p. m.				29.173	41
	3 p. m.	West	0.9			
	9 p. m.	W.NW	0.1		29.218	35
11	3 a. m.	NW	0.2			
	7 a. m.				29.395	29
	9 a. m.	NW	0.4			
	2 p. m.				29.429	30
	3 p. m.	NW	0.6			
	9 p. m.	NW	1.8		29.548	21
12	3 a. m.	Calm	0.0			
	7 a. m.				29.635	16
	9 a. m.	NW	1.7			
	2 p. m.				29.694	22
	3 p. m.	NW	1.9			
	9 p. m.	Calm	0.0		29.691	19
13	3 a. m.	Calm	0.0			
	7 a. m.				29.651	18
	9 a. m.	NW	0.2			
	2 p. m.				29.616	28
	3 p. m.	SE	0.1			
	9 p. m.	Calm	0.0		29.520	27
1863. March 14	3 a. m.	Calm	0.0			
	7 a. m.				29.318	28
	9 a. m.	S. SE	1.2			
	2 p. m.				29.161	37
	3 p. m.	S. SE	0.4			
	9 p. m.	SE	0.1		29.116	36
15	3 a. m.	SE	0.2			
	7 a. m.				29 072	34
	9 a. m.	East	0.1			
	2 p. m.				29.198	39
	3 p. m.	NE	0.3			
	9 p. m.	Calm	0.0		29.391	34
16	3 a. m.	Calm	0.0			
	7 a. m.				29.519	30
	9 a. m.	SE	0.1			
	2 p. m.				29.601	41
	3 p. m.	SE	0.3			
	9 p. m.	Calm	0.0		29.376	38
17	3 a. m.	Calm	0.0			
	7 a. m.				29.291	41
	9 a. m.	NE	0.5			
	2 p. m.				29.359	39
	3 p. m.	N. NE	3.0			
	9 p. m.	N. NE	4.8		29.490	34
18	3 a. m.	N. NE	4.6			
	7 a. m.				29.691	27
	9 a. m.	N. NE	3.2			
	2 p. m.				29.711	33
	3 p. m.	NE	3.8			
	9 p. m.	NE	2.1		29.719	33
19	3 a. m.	E. SE	1.3			
	7 a. m.				29.705	32
	9 a. m.	E. SE	1.2			
	2 p. m.				29.649	37
	3 p. m.	E. NE	1.0			
	9 p. m.	E. SE	1.8		29.624	37
20	3 a. m.	SE	3.2			
	7 a. m.				29.481	32
	9 a. m.	E. SE	2.9			
	2 p. m.				29.467	34
	3 p. m.	E. SE	3.6			
	9 p. m.	SE	3.6		29.413	33
21	3 a. m.	E. SE	0.8			
	7 a. m.				29.370	36
	9 a. m.	Calm	0.0			
	2 p. m.				29.394	40
	3 p. m.	Calm	0.0			
	9 p. m.	E. SE	0.1		29.453	37
22	3 a. m.	E. SE	1.2			
	7 a. m.				29.387	36
	9 a. m.	E. SE	0.2			
	2 p. m.				29.261	39
	3 p. m.	SE	0.4			
	9 p. m.	SE	0.2		29.236	39
23	3 a. m.	Calm	0.0			
	7 a. m.				29.187	39
	9 a. m.	SE	0.3			
	2 p. m.				29.281	40
	3 p. m.	S. SE	0.3			
	9 p. m.	N. NW	1.0		29.196	39
24	3 a. m.	N. NW	1.0			
	7 a. m.				29.068	37
	9 a. m.	NW	1.5			
	2 p. m.				29.052	45
	3 p. m.	W.NW	2.7			
	9 p. m.	W.NW	1.4		29.119	35
25	3 a. m.	NW	0.5			
	7 a. m.				29.156	31
	9 a. m.	N. NW	1.1			
	2 p. m.				29.177	33
	3 p. m.	N. NW	1.2			
	9 p. m.	N. NW	0.8		29.280	3 0

TABLE AA.—*Showing the wind, water, barometer, &c.*—Continued.

Date.	Hour of day.	WIND.		Heig't of water above zero of tide-gauge.	Barometer reduced to 32°.	Therm'r detached.
		Course.	Relative velocity.			
1863.						
Mar. 26	3 a. m.	N. NW	0.8			
	7 a. m.				29.378	24
	9 a. m.	N. NW	0.8			
	2 p. m.				29.374	35
	3 p. m.	NW	0.3			
	9 p. m.	S. SW	0.2		29.437	31
27	3 a. m.	Calm	0.0			
	7 a. m.				29.435	31
	9 a. m.	S. SW	1.2			
	2 p. m.				29.329	40
	3 p. m.	S. SE	1.6			
	9 p. m.	Calm	0.0		29.231	36
28	3 a. m.	N. NE	1.6			
	7 a. m.				29.237	31
	9 a. m.	N. NE	3.3			
	2 p. m.				29.337	32
	3 p. m.	N. NW	3.3			
	9 p. m.	N. NW	4.2		29.482	25
29	3 a. m.	North	2.5			
	7 a. m.				29.634	22
	9 a. m.	NW	1.0			
	2 p. m.				29.676	31
	3 p. m.	E. NE	0.6			
	9 p. m.	Calm	0.0		29.721	28
30	3 a. m.	Calm	0.0			
	7 a. m.				29.681	28
	9 a. m.	SW	1.1			
	2 p. m.				29.467	45
	3 p. m.	SW	2.1			
	9 p. m.	W. NW.	1.4		29.274	39
31	3 a. m.	North	3.4			
	7 a. m.				29.340	30
	9 a. m.	North	5.2			
	2 p. m.				29.462	30
	3 p. m.	N. NW	3.0			
	9 p. m.	E. NE	0.1		29.496	27
April 1	3 a. m.	S. SW	0.1	3.68		
	7 a. m.				29.305	29
	9 a. m.	SW	3.3	3.71		
	2 p. m.				28.971	50
	3 p. m.	W. SW.	4.2	3.84		
	9 p. m.	SW	3.0	3.90	28.768	49
2	3 a. m.	W. NW.	4.8	3.71		
	7 a. m.				28.863	47
	9 a. m.	NW	4.4	3.86		
	2 p. m.				29.010	50
	3 p. m.	NW	4.2	3.83		
	9 p. m.	NW	1.8	3.72	29.138	49
3	3 a. m.	North	3.5	3.52		
	7 a. m.				29.452	30
	9 a. m.	N. NE	6.1	3.42		
	2 p. m.				29.684	33
	3 p. m.	NE	3.5	3.39		
	9 p. m.	NE	0.2	3.46	29.722	30
4	3 a. m.	Calm	0.0	3.43		
	7 a. m.				29.746	30
	9 a. m.	SE	0.8	3.48		
	2 p. m.				29.644	42
	3 p. m.	SE	2.2	3.45		
	9 p. m.	S. SE	0.2	3.49	29.556	37
5	3 a. m.	Calm	0.0	3.45		
	7 a. m.				29.429	38
	9 a. m.	SW	0.6	3.52		
	2 p. m.				29.319	35
	3 p. m.	NE	1.2	3.43		
	9 p. m.	N. NE	3.0	3.50	29.433	41
6	3 a. m.	North	2.9	3.41		
	7 a. m.				29.450	38
	9 a. m.	N. NE	5.4	3.45		
	2 p. m.				29.536	40
	3 p. m.	NE	6.9	3.30		
	9 p. m.	NE	4.6	3.35	29.632	35

Date.	Hour of day.	WIND.		Height of water below 1838.	Barometer reduced to 32°.	Therm'r detached.
		Course.	Relative velocity.			
1863.						
April 7	3 a. m.	N. NE	2.1	3.30		
	7 a. m.				29.664	30
	9 a. m.	N. NE	4.6	3.33		
	2 p. m.				29.672	32
	3 p. m.	NE	4.3	3.27		
	9 p. m.	NE	2.8	3.32	29.712	32
8	3 a. m.	E. SE	1.9	3.33		
	7 a. m.				29.729	35
	9 a. m.	E. SE	1.3	3.50		
	2 p. m.				29.701	38
	3 p. m.	E. SE	1.0	3.47		
	9 p. m.	Calm	0.0	3.50	29.666	33
9	3 a. m.	Calm	0.0	3.45		
	7 a. m.				29.630	35
	9 a. m.	SE	2.0	3.54		
	2 p. m.				29.497	46
	3 p. m.	S. SE	2.6	3.49		
	9 p. m.	S. SE	1.7	3.39	29.344	44
10	3 a. m.	S. SE	0.3	3.39		
	7 a. m.				29.130	46
	9 a. m.	S. SE	0.5	3.45		
	2 p. m.				29.058	46
	3 p. m.	S. SW	0.7	3.37		
	9 p. m.	S. SW	3.4	3.35	29.006	60
11	3 a. m.	SW	2.8	3.41		
	7 a. m.				28.988	58
	9 a. m.	W. SW.	3.9	3.41		
	2 p. m.				29.080	50
	3 p. m.	W. NW.	3.6	3.46		
	9 p. m.	N. NE	3.7	3.23	29.336	39
12	3 a. m.	N. NE	3.7	3.38		
	7 a. m.				29.559	33
	9 a. m.	N. NE	3.6	3.37		
	2 p. m.				29.564	38
	3 p. m.	NE	4.1	3.35		
	9 p. m.	N. NE	0.4	3.35	29.536	33
13	3 a. m.	Calm	0.0	3.42		
	7 a. m.				29.555	34
	9 a. m.	E. SE	0.5	3.41		
	2 p. m.				29.527	45
	3 p. m.	SE	0.6	3.40		
	9 p. m.	E. NE	0.3	3.35	29.499	38
14	3 a. m.	East	0.2	3.33		
	7 a. m.				29.478	40
	9 a. m.	E. NE	1.6	3.32		
	2 p. m.				29.416	46
	3 p. m.	NE	3.7	3.30		
	9 p. m.	NE	3.2	3.25	29.392	41
15	3 a. m.	N. NE	0.6	3.25		
	7 a. m.				29.370	44
	9 a. m.	NE	0.3	3.30		
	2 p. m.				29.394	52
	3 p. m.	NE	3.3	3.34		
	9 p. m.	NE	0.2	3.31	29.368	42
16	3 a. m.	Calm	0.0	3.36		
	7 a. m.				29.382	42
	9 a. m.	E. NE	0.7	3.35		
	2 p. m.				29.384	52
	3 p. m.	SE	0.9	3.36		
	9 p. m.	Calm	0.0	3.31	29.396	44
17	3 a. m.	Calm	0.0	3.37		
	7 a. m.				29.390	45
	9 a. m.	SE	1.8	3.39		
	2 p. m.				29.276	52
	3 p. m.	SE	1.3	3.39		
	9 p. m.	SE	0.5	3.34	29.228	49
18	3 a. m.	S. SE	1.6	3.32		
	7 a. m.				29.146	49
	9 a. m.	SE	3.2	3.30		
	2 p. m.				29.112	60
	3 p. m.	SE	2.8	3.23		
	9 p. m.	W. NW.	0.6	3.11	39.133	55

TABLE AA.—*Showing the wind, water, barometer, &c*—Continued.

Date.	Hour of day.	WIND.		Height of water below 1838.	Barometer reduced to 32°.	Therm'r detached.
		Course.	Relative velocity.			
1863.						
April 19	3 a. m.	W. NW	1.6	3.14		
	7 a. m.				29.259	48
	9 a. m.	W. NW.	0.4	3.18		
	2 p. m.				29.312	52
	3 p. m.	SE	1.8	3.12		
	9 p. m.	SE	0.5	3.22	29.391	43
20	3 a. m.	E. NE	1.0	3.25		
	7 a. m.				29.418	42
	9 a. m.	NE	2.3	3.37		
	2 p. m.				29.409	45
	3 p. m.	NE	2.5	3.24		
	9 p. m.	NE	1.7	8.19	29.436	42
21	3 a. m.	SE	1.6	3.15		
	7 a. m.				29.371	45
	9 a. m.	SE	1.6	3.01		
	2 p. m.				29.402	47
	3 p. m.	SE	1.7	3.00		
	9 p. m.	E. SE	0.7	2.97	29.459	43
22	3 a. m.	NE	0.9	2.97		
	7 a. m.				29.400	46
	9 a. m.	NE	1.6	3.06		
	2 p. m.				29.376	50
	3 p. m.	N. NE	3.7	3.06		
	9 p. m.	NE	2.7	3.11	29.388	42
23	3 a. m.	N. NE	1.3	3.15		
	7 a. m.				29.402	47
	9 a. m.	N. NE	4.2	3.28		
	2 p. m.				29.351	60
	3 p. m.	N. NE	4.1	3.25		
	9 p. m.	N. NE	0.4	3.27	29.356	57
24	3 a. m.			3.25		
	7 a. m.				29.387	54
	9 a. m.	N. NE	2.7	3.32		
	2 p. m.				29.434	61
	3 p. m.	N. NE	4.5	3.26		
	9 p. m.	N. NE	5.5	3.18	29.459	45
25	3 a. m.	N. NE	4.0	3.13		
	7 a. m.				29.537	44
	9 a. m.	E. NE	1.9	3.11		
	2 p. m.				29.567	47
	3 p. m.	NE	3.6	3.16		
	9 p. m.	NE	0.5	3.15	29.546	49
26	3 a. m.	Calm	0.0	3.18		
	7 a. m.				89.577	44
	9 a. m.	E. NE	0.5	3.20		
	2 p. m.				29.577	44
	3 p. m.	E. SE	0.3	3.23		
	9 p. m.	Calm	0.0	3.17	29.511	45
27	3 a. m.	Calm	0.0	3.22		
	7 a. m.				29.467	56
	9 a. m.	Calm	0.0	3.22		
	2 p. m.				29.374	56
	3 p. m.	NE	1.0	3.28		
	9 p. m.	Calm	0.0	3.20	29.293	49
28	3 a. m.	NE	0.7	3.20		
	7 a. m.				29.233	52
	9 a. m.	NE	3.4	3.11		
	2 p. m.				29.196	51
	3 p. m.	N. NE	7.1	3.04		
	9 p. m.	N. NE	7.0	2.95	29.216	52
29	3 a. m.	N. NE	5.9	3.01		
	7 a. m.				29.272	44
	9 a. m.	N. NE	5.3	3.05		
	2 p. m.				29.302	55
	3 p. m.	N. NE	3.4	3.14		
	9 p. m.			3.15	29.344	49
30	3 a. m.			3.23		
	7 a. m.				29.401	50
	9 a. m.	E. NE	0.9	3.20		
	2 p. m.				29.389	56
	3 p. m.	East	0.4	3.23		
	9 p. m.	Calm	0.0	3.16	29.339	51
1863.						
May 1	3 a. m.	Calm	0.0	3.30		
	7 a. m.				29.327	56
	9 a. m.	SW	1.7	3.28		
	2 p. m.				29.236	63
	3 p. m.	SE	2.0	3.30		
	9 p. m.	S. SE	0.1	3.30	29.253	65
2	3 a. m.	NE	1.3	3.35		
	7 a. m.				29.306	44
	9 a. m.	NE	4.1	3.11		
	2 p. m.				29.319	44
	3 p. m.			2.96		
	9 p. m.	NE	3.0	2.95	29.304	45
3	3 a. m.	NE	2.0	2.95		
	7 a. m.				29.270	42
	9 a. m.	NE	1.5	2.95		
	2 p. m.				29.222	44
	3 p. m.	NE	2.0	2.85		
	9 p. m.	NE	2.9	2.88	29.229	42
4	3 a. m.	NE	2.5	2.80		
	7 a. m.				29.175	42
	9 a. m.	NE	2.4	2.84		
	2 p. m.				29.171	43
	3 p. m.	N. NE	2.9	2.88		
	9 p. m.	N. NE	2.9	2.91	29.224	43
5	3 a. m.	N. NE	4.1	2.83		
	7 a. m.				29.225	40
	9 a. m.	N. NE	6.7	2.74		
	2 p. m.				29.344	34
	3 p. m.	N. NE	7.9	2.60		
	9 p. m.	NE	5.1	2.72	29.424	40
6	3 a. m.	E. NE	2.2	2.81		
	7 a. m.				29.400	48
	9 a. m.	NE	6.9	2.92		
	2 p. m.				29.429	48
	3 p. m.	N. NE	7.5	2.93		
	9 p. m.	N. NE	3.9	3.02	29.432	47
7	3 a. m.	N. NE	0.4	3.05		
	7 a. m.				29.452	45
	9 a. m.	N. NE	3.2	3.11		
	2 p. m.				29.407	58
	3 p. m.	N. NE	4.2	3.14		
	9 p. m.	NE	0.4	3.15	29.394	49
8	3 a. m.	N. NE	0.1	3.12		
	7 a. m.				29.450	54
	9 a. m.	W. NW	1.5	3.18		
	2 p. m.				29.318	73
	3 p. m.	W. NW	2.0	3.17		
	9 p. m.	W. NW	0.8	3.15	29.448	62
9	3 a. m.	N. NE	1.0	3.12		
	7 a. m.				29.384	52
	9 a. m.	NE	2.1	3.14		
	2 p. m.				29.301	53
	3 p. m.	E. NE	1.0	3.13		
	9 p. m.	NE	0.4	3.07	29.264	45
10	3 a. m.	SW	0.8	3.05		
	7 a. m.				29.177	59
	9 a. m.	SW	2.4	3.09		
	2 p. m.				29.214	63
	3 p. m.	NE	0.8	3.03		
	9 p. m.	N. NE	4.0	2.98	29.286	45
11	3 a. m.	NE	2.1	3.00		
	7 a. m.				29.391	47
	9 a. m.	NE	1.2	3.05		
	2 p. m.				29.369	50
	3 p. m.	E. NE	0.8	3.03		
	9 p. m.	N. NE	0.3	2.98	29.431	48
12	3 a. m.	Calm	0.0	2.97		
	7 a. m.				29.477	52
	9 a. m.	W. NW	1.5	3.06		
	2 p. m.				29.449	67
	3 p. m.	NW	2.0	3.11		
	9 p. m.	W. NW	0.1	3.04	29.459	55

TABLE AA.—*Showing the wind, water, barometer, &c.*—Continued.

Date.	Hour of day.	WIND.		Height of water below 1838.	Barometer reduced to 32°.	Therm'r detached.	Date.	Hour of day.	WIND.		Height of water below 1838.	Barometer reduced to 32°.	Therm'r detached.
		Course.	Relative velocity.						Course.	Relative velocity.			
1863. May 13	3 a. m.	NW....	0.3	3.12	...	...	1863. May 25	3 a. m.	W. NW.	0.5	2.96	...	...
	7 a. m.	...	...	...	29.392	54		7 a. m.	...	...	...	29.293	56
	9 a. m.	E. NE..	1.0	3.04	...	...		9 a. m.	NE....	1.9	2.98	...	...
	2 p. m.	...	...	...	29.367	55		2 p. m.	...	...	...	29.284	56
	3 p. m.	NE....	0.9	3.02	...	...		3 p. m.	NE....	2.4	2.98	...	...
	9 p. m.	N. NE..	2.2	2.90	29.392	49		9 p. m.	Calm...	0.0	2.95	29.311	54
14	3 a. m.	N. NW.	1.1	3.05	...	...	26	3 a. m.	N. NE..	1.4	2.93	...	...
	7 a. m.	...	...	...	29.532	50		7 a. m.	...	...	...	29.339	51
	9 a. m.	NE....	1.8	3.01	...	...		9 a. m.	NE....	2.4	2.94	...	...
	2 p. m.	...	...	...	29.567	53		2 p. m.	...	...	...	29.374	49
	3 p. m.	E. NE..	1.7	...	...	...		3 p. m.	NE....	2.1	2.89	...	...
	9 p. m.	Calm...	0.0	...	29.554	47		9 p. m.	NE....	0.9	2.88	29.371	55
15	3 a. m.	Calm...	0.0	...	...	...	27	3 a. m.	NE....	2.5	2.91	...	...
	7 a. m.	...	...	...	26.480	48		7 a. m.	...	...	...	29.439	54
	9 a. m.	W. SW.	1.7	...	...	...		9 a. m.	NE....	2.4	2.91	...	...
	2 p. m.	...	...	...	29.214	66		2 p. m.	...	...	...	29.434	64
	3 p. m.	S. SW..	4.5	...	...	...		3 p. m.	NE....	3.5	2.92	...	...
	9 p. m.	SW....	3.2	...	29.006	60		9 p. m.	NE....	1.6	2.89	29.386	56
16	3 a. m.	N. NW.	1.5	...	...	...	28	3 a. m.	N. NE..	0.9	2.94	...	...
	7 a. m.	...	...	...	29.182	55		7 a. m.	...	...	...	29.446	58
	9 a. m.	NW....	3.7	...	...	...		9 a. m.	NE....	1.6	2.94	...	...
	2 p. m.	...	...	...	29.214	61		2 p. m.	...	...	...	29.229	59
	3 p. m.	NW....	4.3	...	...	...		3 p. m.	NE....	2.5	2.94	...	...
	9 p. m.	E. NE..	0.4	...	29.296	47		9 p. m.	N. NE..	1.2	2.91	29.346	61
17	3 a. m.	NW....	1.2	...	...	...	29	3 a. m.	NW....	0.9	2.98	...	...
	7 a. m.	...	...	...	29.357	48		7 a. m.	...	...	...	29.266	57
	9 a. m.	N. NW.	2.5	...	...	...		9 a. m.	E. NE..	0.8	2.95	...	...
	2 p. m.	...	...	...	29.449	53		2 p. m.	...	...	...	29.206	58
	3 p. m.	E. SE..	0.5	3.21	...	...		3 p. m.	SE....	0.3	2.99	...	...
	9 p. m.	E. NE..	0.2	3.14	29.524	46		9 p. m.	NE....	0.6	2.94	29.082	60
18	3 a. m.	Calm...	0.0	3.11	...	...	30	3 a. m.	N. NW.	2.3	2.94	...	...
	7 a. m.	...	...	...	29.595	50		7 a. m.	...	...	...	28.955	59
	9 a. m.	NW....	1.0	3.15	...	...		9 a. m.	N. NE..	1.3	2.97	...	...
	2 p. m.	...	...	...	29.554	63		2 p. m.	...	...	...	28.928	66
	3 p. m.	S. SE..	1.8	3.14	...	...		3 p. m.	W. NW.	0.7	2.99	...	...
	9 p. m.	S. SW..	0.9	3.21	29.522	54		9 p. m.	W. NW.	0.1	2.94	28.912	60
19	3 a. m.	SW....	0.6	3.21	...	...	May 31	3 a. m.	N. NE..	2.2	2.99	...	...
	7 a. m.	...	...	...	29.514	60		7 a. m.	...	...	...	28.895	49
	9 a. m.	SW....	3.3	3.24	...	...		9 a. m.	NE....	1.8	3.04	...	...
	2 p. m.	...	...	...	29.408	76		2 p. m.	...	...	...	28.875	53
	3 p. m.	SW....	3.2	3.25	...	...		3 p. m.	SW....	1.3	3.07	...	...
	9 p. m.	SW....	2.2	3.25	29.373	66		9 p. m.	W. NW.	2.4	3.08	28.918	57
20	3 a. m.	SW....	1.6	3.23	...	...	June 1	3 a. m.	W. NW.	2.6	3.17	...	...
	7 a. m.	...	...	...	29.428	66		7 a. m.	...	...	...	28.943	53
	9 a. m.	SW....	2.9	3.29	...	...		9 a. m.	W. NW.	6.4	3.25	...	...
	2 p. m.	...	...	...	29.405	82		2 p. m.	...	...	...	29.046	59
	3 p. m.	SW....	2.8	3.21	...	...		3 p. m.	W. NW.	5.4	3.18	...	...
	9 p. m.	S. SW..	1.2	3.21	29.425	70		9 p. m.	W. NW.	1.3	3.14	29.159	53
21	3 a. m.	SW....	1.2	3.14	...	...	2	3 a. m.	...	...	3.23	...	...
	7 a. m.	...	...	...	29.518	69		7 a. m.	...	...	...	29.212	54
	9 a. m.	SW....	2.1	3.10	...	...		9 a. m.	W. NW.	2.5	3.24	...	...
	2 p. m.	...	...	...	29.515	73		2 p. m.	...	...	...	29.254	62
	3 p. m.	SE.....	2.4	2.98	...	...		3 p. m.	North..	2.4	3.10	...	...
	9 p. m.	S. SE..	0.3	2.99	29.511	60		9 p. m.	NE....	0.2	3.09	29.366	49
22	3 a. m.	Calm...	0.0	2.95	...	...	3	3 a. m.	Calm...	0.0	3.00	...	...
	7 a. m.	...	...	...	29.538	64		7 a. m.	...	...	...	29.442	54
	9 a. m.	SE.....	1.2	2.99	...	...		9 a. m.	SE....	1.1	3.07	...	...
	2 p. m.	...	...	...	29.461	73		2 p. m.	...	...	...	29.402	60
	3 p. m.	SE.....	1.8	2.96	...	...		3 p. m.	SE....	1.5	3.03	...	...
	9 p. m.	Calm...	0.0	2.96	29.388	61		9 p. m.	W. SW	0.2	3.06	29.359	56
23	3 a. m.	SE.....	0.1	2.92	...	...	4	3 a. m.	W. SW	0.8	3.06	...	...
	7 a. m.	...	...	...	29.303	57		7 a. m.	...	...	...	29.312	58
	9 a. m.	SW....	1.2	2.98	...	...		9 a. m.	W. SW.	2.0	3.08	...	...
	2 p. m.	...	...	...	29.286	70		2 p. m.	...	...	...	29.236	71
	3 p. m.	West...	3.8	2.96	...	...		3 p. m.	West...	2.6	2.97	...	...
	9 p. m.	SW....	2.6	3.00	29.316	63		9 p. m.	NE....	1.0	2.96	29.388	55
24	3 a. m.	W. SW.	1.6	3.00	...	...	5	3 a. m.	E. NE..	1.0	2.93	...	...
	7 a. m.	...	...	...	29.243	61		7 a. m.	...	...	...	29.334	48
	9 a. m.	W. SW.	2.2	3.04	...	...		9 a. m.	NE....	2.4	2.98	...	...
	2 p. m.	...	...	...	29.183	70		2 p. m.	...	...	...	29.421	51
	3 p. m.	W. NW.	2.6	2.98	...	...		3 p. m.	NE....	3.1	2.97	...	...
	9 p. m.	W. NW.	0.5	2.98	29.226	61		9 p. m.	NE....	1.3	...	29.499	48

TABLE AA.—*Showing the wind, water, barometer, &c.*—Continued.

Date.	Hour of day.	Wind.		Height of water below 1838.	Barometer reduced to 32°.	Therm'r detached.	Date.	Hour of day.	Wind.		Height of water below 1838.	Barometer reduced to 32°.	Therm'r detached.
		Course.	Relative velocity.						Course.	Relative velocity.			
1863.							1863.						
June 6	3 a. m.	NE	36	...	...	...	June 18	3 a. m.	W. NW.	0.5	3.11	...	...
	7 a. m.	...	...	...	29.627	47		7 a. m.	...	...	...	29.148	72
	9 a. m.	NE	3.2	...	...	...		9 a. m.	W. NW.	3.0	3.16	...	...
	2 p. m.	...	...	...	29.682	55		2 p. m.	...	...	...	29.077	81
	3 p. m.	NE	4.1	2.88	...	...		3 p. m.	W. NW.	4.0	3.08	...	...
	9 p. m.	N. NE	2.1	2.97	29.724	50		9 p. m.	W. NW.	1.1	3.02	29.138	65
7	3 a. m.	N. NE	2.5	2.94	...	...	19	3 a. m.	Calm	0.0	2.96	...	...
	7 a. m.	...	...	...	29.730	51		7 a. m.	...	...	...	29.121	63
	9 a. m.	E. NE	2.1	3.00	...	...		9 a. m.	West	2.1	3.01	...	...
	2 p. m.	...	...	...	29.712	59		2 p. m.	...	...	...	29.060	72
	3 p. m.	NE	2.7	2.98	...	...		3 p. m.	W. NW.	3.3	2.98	...	...
	9 p. m.	N. NE	1.3	3.00	29.674	50		9 p. m.	N. NW	0.4	2.98	29.133	58
8	3 a. m.	N. NE	1.0	3.01	...	...	20	3 a. m.	W. NW.	1.3	2.98	...	...
	7 a. m.	...	...	...	29.697	56		7 a. m.	...	...	...	29.156	54
	9 a. m.	NE	2.9	3.01	...	...		9 a. m.	W. NW.	2.3	3.03	...	...
	2 p. m.	...	...	...	29.646	64		2 p. m.	...	...	...	29.206	61
	3 p. m.	E. NE	1.1	3.04	...	...		3 p. m.	W. NW.	1.8	2.96	...	...
	9 p. m.	E. NE	0.1	3.02	29.541	53		9 p. m.	W. NW.	0.9	2.99	29.228	58
9	3 a. m.	Calm	0.0	3.05	...	...	21	3 a. m.	W. NW.	1.3	3.03	...	...
	7 a. m.	...	...	...	29.552	56		7 a. m.	...	...	...	29.211	57
	9 a. m.	E. NE	0.8	3.03	...	...		9 a. m.	W. NW.	1.5	3.10	...	...
	2 p. m.	...	...	...	29.459	64		2 p. m.	...	...	...	29.218	67
	3 p. m.	SE	1.5	3.05	...	...		3 p. m.	W. NW.	0.3	3.02	...	...
	9 p. m.	Calm	0.0	3.02	29.414	57		9 p. m.	W. NW.	1.8	3.05	29.241	58
10	3 a. m.	Calm	0.0	3.05	...	...	22	3 a. m.	NW	1.5	2.96	...	...
	7 a. m.	...	...	...	29.352	58		7 a. m.	...	...	...	29.306	55
	9 a. m.	SE	0.3	3.00	...	...		9 a. m.	N. NW	1.5	3.02	...	...
	2 p. m.	...	...	...	29.298	70		2 p. m.	...	...	...	29.371	63
	3 p. m.	SE	0.3	3.05	...	...		3 p. m.	SE	1.5	2.99	...	...
	9 p. m.	Calm	0.0	2.96	29.273	60		9 p. m.	S. SE	0.1	3.05	29.241	57
11	3 a. m.	Calm	0.0	2.98	...	...	23	3 a. m.	S. SE	0.4	3.10	...	...
	7 a. m.	...	...	...	29.281	65		7 a. m.	...	...	...	29.514	56
	9 a. m.	E. SE	0.7	2.95	...	...		9 a. m.	East	1.3	3.12	...	...
	2 p. m.	...	...	...	29.375	75		2 p. m.	...	...	...	29.516	63
	3 p. m.	SE	1.2	2.98	...	...		3 p. m.	SE	1.6	3.09	...	...
	9 p. m.	NE	0.1	2.92	29.341	61		9 p. m.	S. SE	0.2	3.01	29.534	57
12	3 a. m.	N. NE	0.8	2.97	...	...	24	3 a. m.	Calm	0.0	3.00	...	...
	7 a. m.	...	...	...	29.461	58		7 a. m.	...	...	...	29.544	60
	9 a. m.	E. NE	1.9	2.98	...	...		9 a. m.	SE	1.7	3.00	...	...
	2 p. m.	...	...	...	29.471	64		2 p. m.	...	...	...	29.491	71
	3 p. m.	E. SE	0.8	3.02	...	...		3 p. m.	SE	2.0	3.01	...	...
	9 p. m.	Calm	0.0	3.02	29.498	58		9 p. m.	Calm	0.0	2.98	29.481	62
13	3 a. m.	Calm	0.0	3.06	...	...	25	3 a. m.	Calm	0.0	3.01	...	...
	7 a. m.	...	...	...	29.518	63		7 a. m.	...	...	...	29.489	61
	9 a. m.	SE	0.7	3.01	...	...		9 a. m.	E. SE	0.9	3.02	...	...
	2 p. m.	...	...	...	29.510	73		2 p. m.	...	...	...	29.441	72
	3 p. m.	SE	0.8	3.01	...	...		3 p. m.	SE	1.1	3.03	...	...
	9 p. m.	Calm	0.0	3.00	29.508	68		9 p. m.	Calm	0.0	3.00	29.443	64
14	3 a. m.	Calm	0.0	2.99	...	...	26	3 a. m.	Calm	0.0	3.04	...	...
	7 a. m.	...	...	...	29.531	70		7 a. m.	...	...	...	29.449	66
	9 a. m.	S. SW	0.9	3.07	...	...		9 a. m.	E. SE	0.7	2.99	...	...
	2 p. m.	...	...	...	26.469	89		2 p. m.	...	...	...	29.398	73
	3 p. m.	SW	1.9	3.08	...	...		3 p. m.	SE	0.9	3.01	...	...
	9 p. m.	W. SW.	0.9	3.14	29.407	76		9 p. m.	Calm	0.0	2.94	29.378	70
15	3 a. m.	W. NW.	1.3	3.20	...	...	27	3 a. m.	Calm	0.0	2.99	...	...
	7 a. m.	...	...	...	29.445	79		7 a. m.	...	...	...	29.398	69
	9 a. m.	W. NW.	3.3	3.15	...	...		9 a. m.	E. SE	1.4	2.97	...	...
	2 p. m.	...	...	...	29.448	71		2 p. m.	...	...	...	29.345	74
	3 p. m.	NE	3.1	3.03	...	...		3 p. m.	SE	1.9	3.00	...	...
	9 p. m.	N. NE	0.5	2.97	29.440	65		9 p. m.	Calm	0.0	2.96	29.335	71
16	3 a. m.	NE	0.4	2.88	...	...	28	3 a. m.	Calm	0.0	2.98	...	...
	7 a. m.	...	...	...	29.485	65		7 a. m.	...	...	...	29.293	72
	9 a. m.	SE	0.7	2.89	...	...		9 a. m.	SE	1.0	2.99	...	...
	2 p. m.	...	...	...	29.368	79		2 p. m.	...	...	...	29.205	77
	3 p. m.	SE	1.4	2.83	...	...		3 p. m.	SE	1.3	2.98	...	...
	9 p. m.	W. SW.	1.0	2.88	29.264	79		9 p. m.	W. NW.	0.7	2.95	29.155	72
17	3 a. m.	W. SW.	1.8	2.89	...	...	29	3 a. m.	N. NW	0.7	2.90	...	...
	7 a. m.	...	...	...	29.242	77		7 a. m.	...	...	...	29.085	68
	9 a. m.	North	2.4	2.97	...	...		9 a. m.	NE	1.0	2.88	...	...
	2 p. m.	...	...	...	29.252	83		2 p. m.	...	...	...	29.063	77
	3 p. m.	N. NW	2.1	3.04	...	...		3 p. m.	E. NE	1.1	2.86	...	...
	9 p. m.	W. NW.	1.0	3.10	29.245	71		9 p. m.	E. NE	1.8	2.83	29.113	64

TABLE AA.—*Showing the wind, water, barometer, &c.*—Continued.

Date.	Hour of day.	WIND.		Height of water below 1838.	Barometer reduced to 32°.	Therm'r detached.
		Course.	Relative velocity.			
1863.						
June 30	3 a. m.	NE	0.3	2.91		
	7 a. m.				29.191	67
	9 a. m.	E. SE	0.2	2.99		
	2 p. m.				29.221	69
	3 p. m.	E. SE	1.2	3.02		
	9 p. m.	SE	0.5	3.04	29.263	64
July 1	3 a. m.	S. SE	0.7	2.99		
	7 a. m.				29.233	66
	9 a. m.	SE	1.3	2.92		
	2 p. m.				29.155	78
	3 p. m.	West	1.8	2.85		
	9 p. m.	W. SW	0.5		29.244	73
2	3 a. m.	SW	0.9			
	7 a. m.				29.288	71
	9 a. m.	W. NW.	2.3			
	2 p. m.				29.312	79
	3 p. m.	NW	1.8			
	9 p. m.	W. NW.	0.1		29.375	72
3	3 a. m.	W. NW.	0.5			
	7 a. m.				29.428	70
	9 a. m.	W. NW.	2.4	2.97		
	2 p. m.				29.428	82
	3 p. m.	W. NW.	1.4	2.86		
	9 p. m.	Calm	0.0	2.94	29.445	72
4	3 a. m.	Calm	0.0	2.89		
	7 a. m.				29.435	72
	9 a. m.	SE	0.7	2.96		
	2 p. m.				29.415	82
	3 p. m.	SE	1.2	2.86		
	9 p. m.	Calm	0.0	2.97	29.405	72
5	3 a. m.	Calm	0.0	2.87		
	7 a. m.				29.408	73
	9 a. m.	SE	1.2	2.97		
	2 p. m.				29.385	78
	3 p. m.	E. NE	1.1	2.92		
	9 p. m.	Calm	0.0	2.92	29.455	71
6	3 a. m.	N. NE	0.2	2.89		
	7 a. m.				29.332	73
	9 a. m.	E. NE	2.3	2.92		
	2 p. m.				29.352	81
	3 p. m.	NE	1.9	2.86		
	9 p. m.	E. NE	0.2	2.87	29.325	74
7	3 a. m.	Calm	0.0	2.80		
	7 a. m.				29.343	74
	9 a. m.	NE	2.2			
	2 p. m.				29.335	81
	3 p. m.	E. NE	0.8			
	9 p. m.	East	0.1		29.320	72
8	3 a. m.	Calm	0.0			
	7 a. m.				29.335	75
	9 a. m.	East	0.9			
	2 p. m.				29.289	88
	3 p. m.	S. SE	1.1	3.15		
	9 p. m.	NE	0.5	3.10	29.304	75
9	3 a. m.	N. NE	0.2	3.13		
	7 a. m.				29.320	68
	9 a. m.	N. NW	0.4	3.07		
	2 p. m.				29.282	77
	3 p. m.	E. NE	0.1	3.06		
	9 p. m.	Calm	0.0	3.03	29.258	68
10	3 a. m.	Calm	0.0	3.11		
	7 a. m.				29.251	66
	9 a. m.	W. SW	0.1	3.09		
	2 p. m.				29.204	86
	3 p. m.	W. NW.	0.8	3.12		
	9 p. m.	W. NW.	0.1	3.02	29.207	76
1	3 a. m.	N. NE	5.4	2.89		
	7 a. m.				29.395	65
	9 a. m.	NE	5.8	2.78		
	2 p. m.				29.491	59
	3 p. m.	NE	5.4	2.80		
	9 p. m.	NE	5.3	2.77	29.556	57
1863.						
July 12	3 a. m.	NE	4.4	2.72		
	7 a. m.				29.604	52
	9 a. m.	NE	3.4	2.72		
	2 p. m.				29.601	62
	3 p. m.	NE	4.7	2.74		
	9 p. m.	NE	1.2	2.78	29.554	57
13	3 a. m.	N. NW	0.1	2.87		
	7 a. m.				29.481	59
	9 a. m.	E. SE	0.9	2.87		
	2 p. m.				29.408	70
	3 p. m.	SE	1.7	2.95		
	9 p. m.	Calm	0.0	2.92	29.336	59
14	3 a. m.	W. NW.	0.1	2.99		
	7 a. m.				29.299	65
	9 a. m.	SW	1.9	2.99		
	2 p. m.				29.208	82
	3 p. m.	West	3.0	2.92		
	9 p. m.	N. NE	4.1	2.82	29.343	59
15	3 a. m.	N. NW	1.5	2.05		
	7 a. m.				29.483	52
	9 a. m.	NE	2.7	2.94		
	2 p. m.				29.524	63
	3 p. m.	SE	1.3	3.00		
	9 p. m.	SE	0.2	3.01	29.588	57
16	3 a. m.	Calm	0.0	3.09		
	7 a. m.				29.675	58
	9 a. m.	SE	1.6	3.11		
	2 p. m.				29.659	65
	3 p. m.	SE	2.2	3.08		
	9 p. m.	E. SE	0.4	3.07	29.546	57
17	3 a. m.	Calm	0.0	2.98		
	7 a. m.				29.549	57
	9 a. m.	E. NE	1.2	3.00		
	2 p. m.				29.638	66
	3 p. m.	E. NE	1.5	2.92		
	9 p. m.	E. NE	0.6	2.93	29.601	58
18	3 a. m.	Calm	0.0	2.89		
	7 a. m.				29.694	60
	9 a. m.	SE	2.0			
	2 p. m.				29.586	71
	3 p. m.	SE	2.3			
	9 p. m.	E. SE	0.8		29.508	63
19	3 a. m.	Calm	0.0			
	7 a. m.				29.456	65
	9 a. m.	SE	1.7			
	2 p. m.				29.392	70
	3 p. m.	SE	1.1	3.14		
	9 p. m.	S. SE	0.3	3.14	29.308	69
20	3 a. m.	NE	2.3	2.96		
	7 a. m.				29.181	63
	9 a. m.	N. NE	6.6	2.95		
	2 p. m.				29.353	68
	3 p. m.	NE	6.2	2.92		
	9 p. m.	NE	4.6	2.88	29.446	60
21	3 a. m.	N. NE	2.7	2.94		
	7 a. m.				29.498	59
	9 a. m.	NE	2.7	3.02		
	2 p. m.				29.478	63
	3 p. m.	NE	2.0	3.01		
	9 p. m.	NE	0.2	3.11	29.444	55
22	3 a. m.	Calm	0.0	3.09		
	7 a. m.				29.456	59
	9 a. m.	E. SE	1.2	3.14		
	2 p. m.				29.431	69
	3 p. m.	SE	2.0	3.09		
	9 p. m.	SE	0.2	3.09	29.391	64
23	3 a. m.	S. SW	0.6	3.12		
	7 a. m.				29.296	67
	9 a. m.	W. NW.	3.0	3.11		
	2 p. m.				29.287	65
	3 p. m.	W. NW.	3.9	3.11		
	9 p. m.	W. NW.	0.1	3.09	29.348	70

TABLE AA.—*Showing the wind, water, barometer, &c.*—Continued.

Date.	Hour of day.	WIND.		Height of water below 1828.	Barometer reduced 32°.	Therm'r detached.	Date.	Hour of day.	WIND.		Height of water below 1838.	Barometer reduced 32°.	Therm'r detached.
		Course.	Relative velocity.						Course.	Relative velocity.			
1863. July 24	3 a. m.	W. NW	0.2	3.14			1863. Aug. 5	3 a. m.	S. SW	1.8	3.04		
	7 a. m.				29.355	70		7 a. m.				29.288	71
	9 a. m.	NE	0.8	3.14				9 a. m.	W. NW	1.3	3.11		
	2 p. m.				29.355	67		2 p. m.				29.334	82
	3 p. m.	NE	1.3	3.13				3 p. m.	W. NW	1.5	3.10		
	9 p. m.	NE	0.7	3.19	29.328	62		9 p. m.	Calm	0.0	3.06	29.374	75
25	3 a. m.	E. NE	0.3	3.07			6	3 a. m.	N. NW	1.0	3.11		
	7 a. m.				29.208	64		7 a. m.				28.480	67
	9 a. m.	N. NE	1.6	3.08				9 a. m.	NE	3.2	3.04		
	2 p. m.					70		2 p. m.				29.463	71
	3 p. m.	NE	1.8	3.05				3 p. m.	NE	2.3	3.02		
	9 p. m.	SW	0.3	3.02	29.346	63		9 p. m.	NE	0.6	2.99	29.435	66
26	3 a. m.	W. SW	0.6	3.08			7	3 a. m.	S. SE	0.2	2.95		
	7 a. m.				29.188	67		7 a. m.				29.268	66
	9 a. m.			3.16				9 a. m.	W. SW	0.2	2.93		
	2 p. m.				29.163	74		2 p. m.				29.230	76
	3 p. m.			3.25				3 p. m.	NW	1.7	2.94		
	9 p. m.	W. NW	2.5	3.23	29.193	63		9 p. m.	SE	0.2	2.93	29.230	72
27	3 a. m.	W. NW	2.1	3.34			8	3 a. m.	NW	0.1	2.96		
	7 a. m.				29.218	62		7 a. m.				29.198	74
	9 a. m.	NW	2.8	3.28				9 a. m.	SW	1.9	3.09		
	2 p. m.				29.315	76		2 p. m.				29.069	90
	3 p. m.	NW	1.9	3.28				3 p. m.	SW	4.0	3.01		
	9 p. m.	NW	0.6	3.28	29.295	67		9 p. m.	S. SE	1.4	3.10	29.155	72
28	3 a. m.	SW	0.6	3.28			9	3 a. m.	S. SW	1.4	3.07		
	7 a. m.				29.326	66		7 a. m.				29.203	70
	9 a. m.	W. NW	2.0	3.16				9 a. m.	W. SW	1.5	3.09		
	2 p. m.				29.328	74		2 p. m.				29.190	80
	3 p. m.	W. SW	1.9	3.11				3 p. m.	W. NW	2.1	3.09		
	9 p. m.	NW	0.6	3.11	29.331	64		9 p. m.	W. SW	0.2	2.98	29.262	74
29	3 a. m.	S. SW	0.5	3.08			10	3 a. m.	West	0.3	2.99		
	7 a. m.				29.269	68		7 a. m.				29.293	72
	9 a. m.	SE	1.0	3.07				9 a. m.	SE	0.9	2.93		
	2 p. m.				29.235	75		2 p. m.				29.232	87
	3 p. m.	S. SE	1.3	3.07				3 p. m.	S. SE	1.6	2.92		
	9 p. m.	SE	0.2	3.07	29.290	67		9 p. m.	S. SE	1.3	2.78	29.145	73
30	3 a. m.	NE	0.1	3.09			11	3 a. m.	SW	4.2	2.91		
	7 a. m.				29.298	68		7 a. m.				29.063	70
	9 a. m.	E. SE	0.5	3.13				9 a. m.	W. NW.	5.0	2.95		
	2 p. m.				29.318	77		2 p. m.				29.275	77
	3 p. m.	SE	1.2	3.08				3 p. m.	W. NW	3.2	2.98		
	9 p. m.	SE	0.5	2.98	29.363	69		9 p. m.	NW	3.3	2.99	99.388	69
31	3 a. m.	S. SW	1.1	2.98			12	3 a. m.	Calm	0.0	3.13		
	7 a. m.				29.173	70		7 a. m.				29.538	63
	9 a. m.	W. SW	1.9	3.08				9 a. m.	SE	0.8	3.09		
	2 p. m.				29.169	87		2 p. m.				29.525	74
	3 p. m.	W. NW	1.9	3.01				3 p. m.	S. SE	1.7	3.12		
	9 p. m.	SE	0.2	3.05	29.187	74		9 p. m.	Calm	0.0	2.92	29.495	68
Aug. 1	3 a. m.	West	3.3	3.00			13	3 a. m.	Calm	0.0	2.93		
	7 a. m.				29.265	76		7 a. m.				29.431	70
	9 a. m.	W. SW	1.8	3.11				9 a. m.	SW	1.8	2.93		
	2 p. m.				29.281	89		2 p. m.				20.329	86
	3 p. m.	SW	2.6	2.99				3 p. m.	S. SW	3.0	2.94		
	9 p. m.	SW	2.1		29.247	82		9 p. m.	SW	0.2	2.89	29.369	75
2	3 a. m.	SW	1.9				14	3 a. m.	W. SW	0.7			
	7 a. m.				29.317	80		7 a. m.				29.370	72
	9 a. m.	W. SW	2.8					9 a. m.	West	2.1			
	2 p. m.				29.374	86		2 p. m.				29.397	82
	3 p. m.	NW	2.3					3 p. m.	S. SE	1.8			
	9 p. m.	NE	0.1	3.34	29.480	71		9 p. m.	NE	1.9		29.377	77
3	3 a. m.	N. NE	0.2	3.17			15	3 a. m.	NE	1.4	3.02		
	7 a. m.				29.608	69		7 a. m.				29.480	66
	9 a. m.	E. NE	1.4	3.19				9 a. m.	E. SE	1.2	2.92		
	2 p. m.				29.585	76		2 p. m.				29.413	75
	3 p. m.	E. NE	1.3	3.09				3 p. m.	SE	0.8			
	9 p. m.	E. NE	0.3	3.11	29.538	68		9 p. m.	SW	0.4	3.08	29.388	72
4	3 a. m.	Calm	0.0	3.01			16	3 a. m.	SW	0.5	3.19		
	7 a. m.				29.443	71		7 a. m.				29.398	74
	9 a. m.	SE	0.7	3.09				9 a. m.	North	0.4	3.18		
	2 p. m.				29.317	90		2 p. m.				29.360	80
	3 p. m.	SW	2.1	3.02				3 p. m.	NE	1.7	3.20		
	9 p. m.	S. SW	0.9	3.01	29.254	82		9 p. m.	NE	3.3	3.20	29.440	67

TABLE AA.—*Showing the wind, water, barometer, &c.*—Continued.

Date.	Hour of day.	WIND.		Height of water below 1838.	Barometer reduced to 32°.	Therm'r detached.
		Course.	Relative velocity.			
1863.						
Aug. 17	3 a. m.	NE	1.8	3.25	...	...
	7 a. m.	...	...	...	29.538	67
	9 a. m.	East	1.0	3.17	...	...
	2 p. m.	...	...	...	29.565	71
	3 p. m.	E. NE	1.4	3.24	...	...
	9 p. m.	SE	0.7	3.19	29.608	68
18	3 a. m.	S. SW	0.8	3.27	...	...
	7 a. m.	...	...	...	29.583	71
	9 a. m.	S. SE	1.7	3.16	...	...
	2 p. m.	...	...	...	29.523	77
	3 p. m.	SE	1.8	3.14	...	...
	9 p. m.	S. SW	0.4	3.03	29.438	72
19	3 a. m.	Calm	0.0	3.05	...	...
	7 a. m.	...	...	...	29.473	73
	9 a. m.	W. NW.	1.8	3.07	...	...
	2 p. m.	...	...	...	29.407	85
	3 p. m.	S. SE	1.9	3.14	...	...
	9 p. m.	N. NE	1.2	3.09	29.395	69
20	3 a. m.	N. NE	1.5	3.21	...	...
	7 a. m.	...	...	...	29.415	70
	9 a. m.	NE	1.6	3.25	...	...
	2 p. m.	...	...	...	29.428	74
	3 p. m.	East	0.7	3.24	...	...
	9 p. m.	Calm	0.0	3.15	29.383	66
21	3 a. m.	Calm	0.0	3.14	...	...
	7 a. m.	...	...	...	29.381	68
	9 a. m.	W. SW.	1.9	3.10	...	...
	2 p. m.	...	...	...	29.232	85
	3 p. m.	SW	2.4	3.06	...	...
	9 p. m.	SW	0.8	3.07	29.232	72
22	3 a. m.	SW	1.4	3.00	...	...
	7 a. m.	...	...	...	29.238	68
	9 a. m.	NE	3.1	3.16	...	...
	2 p. m.	...	...	...	29.333	63
	3 p. m.	NE	2.4	3.16	...	...
	9 p. m.	E. NE	0.5	3.16	29.396	60
23	3 a. m.	SE	1.4	3.19	...	...
	7 a. m.	...	...	...	29.376	60
	9 a. m.	SE	1.1	3.25	...	...
	2 p. m.	...	...	...	29.221	61
	3 p. m.	E. NE	2.8	3.33	...	...
	9 p. m.	SW	1.8	3.18	28.975	68
24	3 a. m.	NW	4.0	3.28	...	...
	7 a. m.	...	...	...	29.241	53
	9 a. m.	N. NW.	3.2	3.53	...	...
	2 p. m.	...	...	...	29.444	60
	3 p. m.	NW	2.4	3.36	...	...
	9 p. m.	NW	0.7	3.24	29.569	52
25	3 a. m.	N. NW.	0.9	3.16	...	...
	7 a. m.	...	...	...	29.655	49
	9 a. m.	N. NW.	1.1	3.24	...	...
	2 p. m.	...	...	...	29.629	62
	3 p. m.	SE	1.5	3.20	...	...
	9 p. m.	SW	0.1	3.19	29.596	53
26	3 a. m.	W. SW.	1.2	3.10	...	...
	7 a. m.	...	...	...	29.560	55
	9 a. m.	W. SW.	3.0	3.15	...	...
	2 p. m.	...	...	...	29.446	74
	3 p. m.	West	3.4	3.14	...	...
	9 p. m.	SW	0.8	3.19	29.423	62
27	3 a. m.	W. SW.	1.5	3.14	...	...
	7 a. m.	...	...	...	29.391	61
	9 a. m.	W. SW.	1.6	3.23	...	...
	2 p. m.	...	...	...	29.258	69
	3 p. m.	S. SE	2.2	3.16	...	...
	9 p. m.	S. SW	2.2	3.06	29.108	57
28	3 a. m.	W. NW.	1.8	3.06	...	...
	7 a. m.	...	...	...	28.971	58
	9 a. m.	W. NW.	4.2	3.08	...	...
	2 p. m.	...	...	...	29.094	58
	3 p. m.	NW	3.9	3.24	...	...
	9 p. m.	N. NW.	2.4	3.20	29.278	46
1863.						
Aug. 29	3 a. m.	NW	2.2	3.13	...	...
	7 a. m.	...	...	...	29.300	43
	9 a. m.	N. NW.	3.9	3.11	...	...
	2 p. m.	...	...	...	29.501	55
	3 p. m.	NW	3.7	3.10	...	...
	9 p. m.	Calm	0.0	2.96	29.579	47
30	3 a. m.	Calm	0.0	2.95	...	...
	7 a. m.	...	...	...	29.691	47
	9 a. m.	W. SW.	1.3	2.96	...	...
	2 p. m.	...	...	...	29.646	65
	3 p. m.	S. SE	2.8	2.99	...	...
	9 p. m.	Calm	0.0	2.96	29.626	53
31	3 a. m.	SW	0.4	3.03	...	...
	7 a. m.	...	...	...	29.604	51
	9 a. m.	SW	1.9	3.03	...	...
	2 p. m.	...	...	...	29.538	67
	3 p. m.	S. SE	2.8	3.07	...	...
	9 p. m.	S. SW	0.7	2.97	29.586	58
Sept. 1	3 a. m.	SW	0.5	3.39	...	...
	7 a. m.	...	...	...	29.509	55
	9 a. m.	S. SW	1.2	3.40	...	...
	2 p. m.	...	...	...	29.408	69
	3 p. m.	S. SE	1.6	3.42	...	...
	9 p. m.	S. SE	0.2	3.45	29.363	62
2	3 a. m.	N. NE	4.3	3.68	...	...
	7 a. m.	...	...	...	29.499	54
	9 a. m.	NE	6.2	3.77	...	...
	2 p. m.	...	...	...	29.573	57
	3 p. m.	NE	6.5	3.83	...	...
	9 p. m.	NE	4.5	3.77	29.601	54
3	3 a. m.	NE	2.6	3.83	...	...
	7 a. m.	...	...	...	29.649	55
	9 a. m.	E. NE	2.6	3.75	...	...
	2 p. m.	...	...	...	29.626	58
	3 p. m.	NE	3.1	3.67	...	...
	9 p. m.	NE	0.4	3.57	29.576	53
4	3 a. m.	NE	0.1	3.56	...	...
	7 a. m.	...	...	...	29.516	57
	9 a. m.	S. SE	2.8	...	...	...
	2 p. m.	...	...	...	29.366	66
	3 p. m.	S. SE	3.0	...	...	...
	9 p. m.	S. SE	0.7	3.81	29.253	62
5	3 a. m.	W. NW.	1.2	3.78	...	...
	7 a. m.	...	...	...	29.268	63
	9 a. m.	W. NW.	2.3	3.87	...	...
	2 p. m.	...	...	...	29.280	78
	3 p. m.	N. NW.	2.9	3.75	...	...
	9 p. m.	N. NW.	0.9	3.69	29.435	60
6	3 a. m.	NE	2.5	3.73	...	...
	7 a. m.	...	...	...	29.568	56
	9 a. m.	NE	2.7	3.70	...	...
	2 p. m.	...	...	...	29.578	59
	3 p. m.	E. NE	1.6	3.69	...	...
	9 p. m.	SE	0.6	3.72	29.558	53
7	3 a. m.	S. SE	0.5	3.76	...	...
	7 a. m.	...	...	...	29.544	54
	9 a. m.	S. SE	1.4	3.74	...	...
	2 p. m.	...	...	...	29.306	67
	3 p. m.	S. SE	1.7	3.64	...	...
	9 p. m.	SE	0.1	3.75	29.296	63
8	3 a. m.	N. NW.	0.2	3.68	...	...
	7 a. m.	...	...	...	29.488	63
	9 a. m.	NE	4.3	3.78	...	...
	2 p. m.	...	...	...	29.636	58
	3 p. m.	NE	4.7	3.68	...	...
	9 p. m.	NE	2.7	3.64	29.707	56
9	3 a. m.	E. NE	2.2	3.60	...	...
	7 a. m.	...	...	...	29.745	55
	9 a. m.	E. NE	2.0	3.66	...	...
	2 p. m.	...	...	...	29.704	58
	3 p. m.	E. NE	1.6	3.71	...	...
	9 p. m.	Calm	0.0	3.69	29.651	48

TABLE AA.—*Showing the wind, water, barometer, &c.*—Continued.

Date.	Hour of day.	Wind.		Height of water below 1838.	Barometer reduced to 32°.	Therm'r detached.
		Course.	Relative velocity.			
1863. Sept. 10	3 a. m.	Calm	0.0	3.70		
	7 a. m.				29.612	55
	9 a. m.	S. SW	1.7	3.69		
	2 p. m.				29.508	63
	3 p. m.	S. SE	1.6	3.61		
	9 p. m.	S. SW	2.5	3.67	29.348	65
11	3 a. m.	W. SW	2.9	3.63		
	7 a. m.				29.306	69
	9 a. m.	W. NW	2.9	3.63		
	2 p. m.				29.368	76
	3 p. m.	W. NW	2.5	3.59		
	9 p. m.	N. NW	1.7	3.63	29.425	66
12	3 a. m.	NE	3.9	3.64		
	7 a. m.				29.496	57
	9 a. m.	NE	4.3	3.74		
	2 p. m.				29.486	61
	3 p. m.	NE	2.3	3.73		
	9 p. m.	Calm	0.0	3.71	29.443	53
13	3 a. m.	Calm	0.0	3.65		
	7 a. m.				29.429	52
	9 a. m.	SW	1.8	3.67		
	2 p. m.				29.341	73
	3 p. m.	SW	2.9	3.53		
	9 p. m.	SW	0.7	3.56	29.328	64
14	3 a. m.	S. SW	0.1	3.52		
	7 a. m.				29.378	61
	9 a. m.	S. SW	2.5	3.48		
	2 p. m.				29.315	82
	3 p. m.	S. SW	4.0	3.50		
	9 p. m.	SW	2.5	3.44	29.343	71
15	3 a. m.	SW	2.3	3.42		
	7 a. m.				29.393	67
	9 a. m.	SW	2.5	3.41		
	2 p. m.				29.339	86
	3 p. m.	SE	2.0	3.43		
	9 p. m.	S. SW	1.2	2.36	29.342	71
16	3 a. m.	S. SE	0.2	3.46		
	7 a. m.				29.318	66
	9 a. m.	South	1.3	3.49		
	2 p. m.				29.207	85
	3 p. m.	S. SW	3.0	3.57		
	9 p. m.	S. SW	3.0	3.44	29.140	73
17	3 a. m.	S. SW	2.2	3.57		
	7 a. m.				28.995	69
	9 a. m.	W. NW	2.9	3.47		
	2 p. m.				29.095	67
	3 p. m.	W. NW	3.6	3.61		
	9 p. m.	N. NE	3.5	3.60	29.278	47
18	3 a. m.	N. NW	3.6	3.45		
	7 a. m.				29.462	38
	9 a. m.	N. NW	3.5	3.54		
	2 p. m.				29.476	43
	3 p. m.	N. NW	2.6	3.66		
	9 p. m.	N. NW	1.3	3.65	29.494	40
19	3 a. m.	North	1.6	3.60		
	7 a. m.				29.509	34
	9 a. m.	NW	1.9	3.65		
	2 p. m.				29.413	48
	3 p. m.	W. SW	1.8	3.66		
	9 p. m.	S. SW	1.0	3.48	29.381	47
20	3 a. m.	SW	2.6	3.30		
	7 a. m.				29.324	50
	9 a. m.	SW	3.1	3.35		
	2 p. m.				29.268	67
	3 p. m.	W. SW	3.4	3.36		
	9 p. m.	NE	1.4	3.55	29.328	58
21	3 a. m.	N. NE	1.4	3.61		
	7 a. m.				29.534	51
	9 a. m.	NE	2.6	3.67		
	2 p. m.				29.624	57
	3 p. m.	E. NE	2.0	3.65		
	9 p. m.	E. NE	1.0	3.53	29.744	51
1863. Sept. 22	3 a. m.	SE	0.3	3.52		
	7 a. m.				29.828	44
	9 a. m.	S. SE.	2.9	3.49		
	2 p. m.				29.759	59
	3 p. m.	S. SE	3.1	3.44		
	9 p. m.	S. SE	2.7	3.47	29.576	61
23	3 a. m.	S. SW	3.1	3.30		
	7 a. m.				29.456	57
	9 a. m.	SW	3.8	3.34		
	2 p. m.				29.358	77
	3 p. m.	W. SW	2.8	3.42		
	9 p. m.	N. NE	3.8	3.66	29.478	55
24	3 a. m.	N. NE	3.8	3.58		
	7 a. m.				29.652	45
	9 a. m.	N. NE	3.8	3.74		
	2 p. m.				29.679	48
	3 p. m.	N. NE	4.0	3.74		
	9 p. m.	N. NE	3.7	3.75	29.729	48
25	3 a. m.	E. NE	2.4	3.70		
	7 a. m.				29.730	48
	9 a. m.	E. NE	2.2	3.72		
	2 p. m.				29.699	50
	3 p. m.	E. NE	1.7	3.57		
	9 p. m.	E. SE	0.1	3.56	29.636	47
26	3 a. m.	Calm	0.0	3.48		
	7 a. m.				29.582	42
	9 a. m.	S. SW	2.1	3.50		
	2 p. m.				29.478	58
	3 p. m.	S. SE	3.2	3.43		
	9 p. m.	S. SE	1.4	3.47	29.351	55
27	3 a. m.	S. SE	1.3	3.45		
	7 a. m.				29.306	51
	9 a. m.	SW	2.1	3.47		
	2 p. m.				29.225	80
	3 p. m.	SW	2.1	3.50		
	9 p. m.	SW	1.5	3.49	29.265	69
28	3 a. m.	W. SW	1.1	3.51		
	7 a. m.				29.383	62
	9 a. m.	W. SW	0.7	3.52		
	2 p. m.				29.379	72
	3 p. m.	SE	0.7	3.44		
	9 p. m.	S. SW	0.2	3.34	29.375	67
29	3 a. m.	W. SW	0.1	3.38		
	7 a. m.				29.441	58
	9 a. m.	SE	0.4	3.41		
	2 p. m.				29.398	69
	3 p. m.	S. SE.	1.5	3.47		
	9 p. m.	Calm	0.0	3.46	29.415	60
30	3 a. m.	Calm	0.0	3.53		
	7 a. m.				29.383	54
	9 a. m.	SE	0.7	3.55		
	2 p. m.				29.266	69
	3 p. m.	S. SE	1.5	3.63		
	9 p. m.	West	2.0	3.49	29.246	65
Oct. 1	3 a. m.	W. SW	1.6	3.41		
	7 a. m.				29.301	48
	9 a. m.	S. SE	1.8	3.41		
	2 p. m.				29.196	58
	3 p. m.	S. SE	2.9	3.40		
	9 p. m.	W. NW	1.7	3.38	29.164	49
2	3 a. m.	West	1.5	3.40		
	7 a. m.				29.207	45
	9 a. m.	W. NW	2.9	3.41		
	2 p. m.				29.279	54
	3 p. m.	West	1.6	3.39		
	9 p. m.	Calm	0.0	3.32	29.312	50
3	3 a. m.	SW	0.6	3.41		
	7 a. m.				29.147	51
	9 a. m.	SE	2.8	3.57		
	2 p. m.				28.948	55
	3 p. m.	S. SW	2.5	3.64		
	9 p. m.	West	4.2	3.56	28.976	41

TABLE AA.—*Showing the wind, water, barometer, &c.*—**Continued.**

Date.	Hour of day.	WIND.		Height of water below 1838.	Barometer reduced to 32°.	Therm'r detached.	Date.	Hour of day.	WIND.		Height of water below 1838.	Barometer reduced to 32°.	Therm'r detached.
		Course.	Relative velocity.						Course.	Relative velocity.			
1863. Oct. 4	3 a. m.	W.NW	4.2	3.55			1863. Oct. 16	3 a. m.	Calm	0.0	3.68		
	7 a. m.				29.084	38		7 a. m.				29.141	52
	9 a. m.	W.NW.	4.0	3.67				9 a. m.	Calm	0.0	3.72		
	2 p. m.				29.211	50		2 p. m.				29.001	57
	3 p. m.	W.NW	3.6	3.64				3 p. m.	E. NE	0.4	3.78		
	9 p. m.	W.NW	2.4	3.55	29.344	41		9 p. m.	Calm	0.0	3.73	28.970	53
5	3 a. m.	W.NW	2.1	3.47			17	3 a. m.	E. SE	0.1	3.83		
	7 a. m.				29.450	39		7 a. m.				28.905	55
	9 a. m.	W.NW	2.3	3.42				9 a. m.	S. SE	2.5	3.80		
	2 p. m.				29.469	45		2 p. m.				28.738	6
	3 p. m.	W.NW	2.0					3 p. m.	S. SW	2.1	3.84		
	9 p. m.	West	2.1		29.494	37		9 p. m.	S. SW	3.3	3.74	28.878	52
6	3 a. m.	W. SW	0.1				18	3 a. m.	S. SW	4.8	3.49		
	7 a. m.				29.392	35		7 a. m.				28.893	42
	9 a. m.	W. SW	0.6					9 a. m.	SW	5.8	3.25		
	2 p. m.				29.331	51		2 p. m.				28.978	43
	3 p. m.	SE	1.3	3.76				3 p. m.	SW	5.1	2.98		
	9 p. m.	NE	1.0	3.84	29.382	48		9 p. m.	SW	2.2	3.09	29.161	41
7	3 a. m.	NE	2.1	3.84			19	3 a. m.	S. SW	0.9	3.11		
	7 a. m.				29.417	40		7 a. m.				29.190	35
	9 a. m.	NE	2.4	3.90				9 a. m.	S. SW	1.6	3.18		
	2 p. m.				29.417	49		2 p. m.				29.081	53
	3 p. m.	NE	1.3	3.78				3 p. m.	S. SE	3.8	3.18		
	9 p. m.	S.SW	0.1	3.70	29.403	43		9 p. m.	South	4.1	3.23	29.071	54
8	3 a. m.	SW	1.3	3.58			20	3 a. m.	S.SW	3.0	3.16		
	7 a. m.				29.264	45		7 a. m.				29.034	45
	9 a. m.	S.SW	2.0	3.66				9 a. m.	W. SW	2.9	3.43		
	2 p. m.				29.153	58		2 p. m.				29.201	46
	3 p. m.	N. NW	2.0	3.65				3 p. m.	W. SW	3.0	3.25		
	9 p. m.	N. NW	1.1	3.79	29.279	44		9 p. m.	W. SW	1.1	3.21	29.384	37
9	3 a. m.	North	3.0	3.90			21	3 a. m.	W. SW	1.3	3.08		
	7 a. m.				29.454	44		7 a. m.				29.594	35
	9 a. m.	N. NE	4.7	4.06				9 a. m.	W.NW	2.8	3.20		
	2 p. m.				29.552	48		2 p. m.				29.701	44
	3 p. m.	NE	3.8	4.03				3 p. m.	NW	1.8	3.19		
	9 p. m.	NE	3.9	3.98	29.638	46		9 p. m.	W.NW	1.4	3.26	29.831	37
10	3 a. m.	N. NW	1.8	3.83			22	3 a. m.	NW	0.9	3.35		
	7 a. m.				29.745	34		7 a. m.				29.871	33
	9 a. m.	N. NW	2.3	3.86				9 a. m.	NW	1.0	3.53		
	2 p. m.				29.725	47		2 p. m.				29.763	39
	3 p. m.	NE	1.6	3.77				3 p. m.	N. NW	1.0	3.56		
	9 p. m.	E. NE	0.1	3.76	29.721	37		9 p. m.	Calm	0.0	3.61	29.754	35
11	3 a. m.	Calm	0.0	3.73			23	3 a. m.	W.NW	0.8	3.60		
	7 a. m.				29.714	32		7 a. m.				29.405	33
	9 a. m.	S. SW	1.5	3.79				9 a. m.	W.NW.	2.7	3.66		
	2 p. m.				29.601	51		2 p. m.				29.415	35
	3 p. m.	S. SE	2.8	3.77				3 p. m.	W.NW	3.7	3.56		
	9 p. m.	SE	1.9	3.80	29.496	48		9 p. m.	W.NW	3.1	3.65	29.621	31
12	3 a. m.	S. SE.	2.6	3.83			24	3 a. m.	N. NW	2.1	3.68		
	7 a. m.				29.372	49		7 a. m.				29.752	32
	9 a. m.	SE	3.8	3.90				9 a. m.	North	2.6	3.63		
	2 p. m.				29.356	52		2 p. m.				29.817	38
	3 p. m.	E. NE	3.2	3.92				3 p. m.	N. NE	2.9	3.58		
	9 p. m.	E. NE	2.5	3.87	29.378	52		9 p. m.	North	1.7	3.58	29.899	34
13	3 a. m.	E.SE	2.3	3.86			25	3 a. m.	N. NW	1.7	3.54		
	7 a. m.				29.412	49		7 a. m.				29.967	29
	9 a. m.	E. SE	1.6	3.79				9 a. m.	N. NE	1.9	3.61		
	2 p. m.				29.369	58		2 p. m.				29.924	41
	3 p. m.	E. NE	1.6	3.77				3 p. m.	NE	1.0	3.61		
	9 p. m.	NE	0.3	3.67	29.371	49		9 p. m.	Calm	0.0	3.56	29.919	35
14	3 a. m.	Calm	0.0	3.70			26	3 a. m.	NE	0.1	3.57		
	7 a. m.				29.374	43		7 a. m.				29.910	31
	9 a. m.	N. NW	0.7	3.63				9 a. m.	NE	0.4	3.60		
	2 p. m.				29.326	58		2 p. m.				29.874	43
	3 p. m.	SE	1.5	3.67				3 p. m.	E. NE	1.0	3.57		
	9 p. m.	Calm	0.0	3.53	29.353	51		9 p. m.	E. NE	0.1	3.55	29.845	37
15	3 a. m.	Calm	0.0	3.59			27	3 a. m.	NE	0.1	3.56		
	7 a. m.				29.371	44		7 a. m.				29.894	32
	9 a. m.	SE	0.7	3.62				9 a. m.	N. NE	0.7	3.58		
	2 p. m.				29.264	58		2 p. m.				29.767	44
	3 p. m.	SE	1.9	3.67				3 p. m.	SE	1.3	3.58		
	9 p. m.	Calm	0.0	3.62	29.226	52		9 p. m.	E.SE	0.2	3.56	29.729	35

Table AA.—*Showing the wind, water, barometer, &c.*—Continued.

Date.	Hour of day.	WIND.		Height of water below 1838.	Barometer reduced to 32°.	Therm'r detached.
		Course.	Relative velocity.			
1863.						
Oct. 28	3 a. m.	Calm	0.0	3.50		
	7 a. m.				29.663	37
	9 a. m.	S.SE	1.8	3.49		
	2 p. m.				29.557	48
	3 p. m.	SE	3.2	3.44		
	9 p. m.	S.SE	2.3	3.35	29.509	46
29	3 a. m.	S.SE	0.9	3.39		
	7 a. m.				29.360	40
	9 a. m.	S.SE	1.4	3.39		
	2 p. m.				29.115	46
	3 p. m.	South	2.6	3.56		
	9 p. m.	S.SW	2.4	3.52	28.967	53
30	3 a. m.	W.NW	2.4	3.72		
	7 a. m.				29.111	36
	9 a. m.	N.NE	2.0	3.69		
	2 p. m.				29.126	38
	3 p. m.	N.NW	2.1	3.72		
	9 p. m.	NW	2.9	3.57	29.163	34
31	3 a. m.	NW	1.9	3.58		
	7 a. m.				29.502	30
	9 a. m.	W.NW	1.1	3.46		
	2 p. m.				29.654	36
	3 p. m.	NW	0.6	3.44		
	9 p. m.	Calm	0.0	3.35	29.732	31
Nov. 1	3 a. m.	Calm	0.0	3.48		
	7 a. m.				29.747	33
	9 a. m.	SE	1.8	3.59		
	2 p. m.				29.664	41
	3 p. m.	E.SE	2.7	3.68		
	9 p. m.	SE	3.6	3.76	29.508	44
2	3 a. m.	S.SE	2.6	3.65		
	7 a. m.				29.240	44
	9 a. m.	SW	3.3	3.64		
	2 p. m.				29.161	56
	3 p. m.	W.SW	4.4			
	9 p. m.	West	3.8		29.342	41
3	3 a. m.	West	2.0			
	7 a. m.				29.560	33
	9 a. m.	W.NW	3.0			
	2 p. m.				29.580	48
	3 p. m.	W.SW	2.3			
	9 p. m.	S.SW	0.4		29.566	39
4	3 a. m.	S.SW	1.1			
	7 a. m.				29.465	41
	9 a. m.	S.SW	1.7	4.38		
	2 p. m.				29.256	46
	3 p. m.	S.SE	1.9	4.16		
	9 p. m.	E.NE	1.6	3.93	28.957	46
5	3 a. m.	W.SW	4.1	3.97		
	7 a. m.				29.169	45
	9 a. m.	W. NW.	3.3	3.89		
	2 p. m.				29.252	55
	3 p. m.	W.SW	2.4	4.05		
	9 p. m.	West	3.8	4.14	29.296	45
6	3 a. m.	W.NW	2.7	4.19		
	7 a. m.				29.402	34
	9 a. m.	W.SW	2.0	4.21		
	2 p. m.				29.386	48
	3 p. m.	S.SW	1.8	4.24		
	9 p. m.	S.SW	2.1	4.15	29.098	44
7	3 a. m.	West	3.5	4.13		
	7 a. m.				29.107	45
	9 a. m.	W.NW	4.0	3.95		
	2 p. m.				29.216	51
	3 p. m.	W.NW	3.9	3.76		
	9 p. m.	North	1.9	3.71	29.518	40
8	3 a. m.	NW	1.8	3.89		
	7 a. m.				29.681	32
	9 a. m.	NW	3.2	3.87		
	2 p. m.				29.701	33
	3 p. m.	W.NW	3.3	4.01		
	9 p. m.	NW	2.7	3.90	29.731	30
1863.						
Nov. 9	3 a. m.	NW	2.2	3.94		
	7 a. m.				29.771	26
	9 a. m.	N.NW	3.3	3.79		
	2 p. m.				29.820	32
	3 p. m.	N.NW	3.1	3.85		
	9 p. m.	NW	0.9	3.79	29.877	26
10	3 a. m.	NW	0.5	3.87		
	7 a. m.				29.728	23
	9 a. m.	SW	2.6	4.00		
	2 p. m.				29.564	38
	3 p. m.	S SW	4.1	4.30		
	9 p. m.	SW	4.2	4.20	29.357	37
11	3 a. m.	SW	3.8	4.34		
	7 a. m.				29.117	41
	9 a. m.	SW	4.2	4.41		
	2 p. m.				29.088	52
	3 p. m.	SW	2.8	4.27		
	9 p. m.	SW	1.2	4.12	29.115	48
12	3 a. m.	SW	0.6	3.95		
	7 a. m.				29.096	45
	9 a. m.	S.SW	3.6	3.93		
	2 p. m.				28.995	56
	3 p. m.	S.SW	2.0	3.84		
	9 p. m.	SW	1.0	3.77	29.052	49
13	3 a. m.	S.SW	0.3	3.68		
	7 a. m.				29.136	54
	9 a. m.	East	0.2	3.66		
	2 p. m.				29.209	47
	3 p. m.	N.NE	1.6	3.60		
	9 p. m.	N NE	3.6	3.67	29.045	44
14	3 a. m.	N.NW	5.7	3.35		
	7 a. m.				29.028	40
	9 a. m.	N.NW	4.0	3.35		
	2 p. m.				29.130	36
	3 p. m.	N.NW	3.0	3.45		
	9 p. m.	N.NW	2.7	3.47	29.244	36
15	3 a. m.	NW	1.6	3.47		
	7 a. m.				29.330	35
	9 a. m.	N.NW	2.4	3.47		
	2 p. m.				29.381	36
	3 p. m.	N.NW	2.7	3.49		
	9 p. m.	N.NW	1.5	3.52	29.429	38
16	3 a. m.	N.NW	2.0	3.59		
	7 a. m.				29.455	35
	9 a. m.	N.NW	1.5	3.66		
	2 p. m.				29.391	43
	3 p. m.	N.NE	1.2	3.65		
	9 p. m.	N.NE	0.1	3.63	29.372	35
17	3 a. m.	N.NW	0.1	3.61		
	7 a. m.				29.337	38
	9 a. m.	SW	0.5	3.66		
	2 p. m.				29.254	44
	3 p. m.	SW	0.6	3.67		
	9 p. m.	S.SW	0.7	3.73	29.186	37
18	3 a. m.	S.SE	1.5	3.79		
	7 a. m.				28.933	36
	9 a. m.	S.SW	2.0	3.91		
	2 p. m.				28.843	53
	3 p. m.	W.SW	1.1	3.92		
	9 p. m.	SW	0.6	3.91	28.920	47
19	3 a. m.	S.SW	1.4	3.89		
	7 a. m.				28.918	50
	9 a. m.	W.NW	2.6	3.89		
	2 p. m.				29.052	46
	3 p. m.	W.NW	3.4	3.87		
	9 p. m.	W.NW	3.6	3.90	29.176	39
20	3 a. m.	West	2.4	4.03		
	7 a. m.				29.322	31
	9 a. m.	SW	2.1	4.13		
	2 p. m.				29.219	44
	3 p. m.	S.SW	3.0	4.31		
	9 p. m.	S.SW	2.6	4.25	29.259	39

TABLE AA.—*Showing the wind, water, barometer, &c.*—**Continued.**

Date.	Hour of day.	WIND.		Height of water below 1838.	Barometer reduced to 32°.	Therm'r detached.
		Course.	Relative velocity.			
1863. Nov. 21	3 a. m.	SW	2.1	4.19		
	7 a. m.				29.212	35
	9 a. m.	S.SW	1.5	4.01		
	2 p. m.				29.216	37
	3 p. m.	W.NW	3.0	4.02		
	9 p. m.	W.NW	3.2	3.95	29.427	32
22	3 a. m.	W.SW.	1.3	4.07		
	7 a. m.				29.705	26
	9 a. m.	West	1.7	4.04		
	2 p. m.				29.780	36
	3 p. m.	W.SW.	1.2	4.21		
	9 p. m.	Calm	0.0	4.07	29.849	34
23	3 a. m.	N.NE	2.0	3.97		
	7 a. m.				29.859	33
	9 a. m.	NE	2.3	3.85		
	2 p. m.				29.712	36
	3 p. m.	NE	3.7	3.73		
	9 p. m.	E.NE	3.5	3.53	29.531	36
24	3 a. m.	E.NE	3.0	3.51		
	7 a. m.				29.088	35
	9 a. m.	E.NE	2.4	3.47		
	2 p. m.				29.098	31
	3 p. m.	NW	3.5	3.52		
	9 p. m.	W.SW	2.7	3.52	29.328	26
25	3 a. m.	W.SW.	1.4	3.72		
	7 a. m.				29.360	21
	9 a. m.	E.NE	1.3	3.91		
	2 p. m.				29.271	33
	3 p. m.	W.SW.	2.2	4.02		
	9 p. m.	W.SW.	2.9	4.07	29.358	24
26	3 a. m.	S.SW	1.2	4.07		
	7 a. m.				29.341	31
	9 a. m.	S.SW	2.8	4.28		
	2 p. m.				29.266	41
	3 p. m.	S.SW	2.0	4.05		
	9 p. m.	S SW	2.0	4.12	29.306	38
27	3 a. m.	SW	1.1	3.93		
	7 a. m.				29.260	32
	9 a. m.	SW	1.9	3.93		
	2 p. m.				29.141	42
	3 p. m.	W.SW.	1.3	3.80		
	9 p. m.	W.NW	2.9	3.82	29.196	31
28	3 a. m.	W.NW	3.0	3.72		
	7 a. m.				29.230	25
	9 a. m.	W.NW	3.1	3.78		
	2 p. m.				29.318	23
	3 p. m.	N NW	3.5	3.82		
	9 p. m.	W.NW	2.6	3.93	29.456	19
29	3 a. m.	W.NW	2.9	3.92		
	7 a. m.				29.535	7
	9 a. m.	W.NW	3.3	4.03		
	2 p. m.				29.542	11
	3 p. m.	W.NW	3.2	3.99		
	9 p. m.	West	2.0		29.649	9
30	3 a. m.	W.SW.	1.8			
	7 a. m.				29.720	9
	9 a. m.	West	2.2			
	2 p. m.				29.707	21
	3 p. m.	W.SW.	1.8			
	9 p. m.	SW	1.8		29.646	25
Dec. 1	3 a. m.	W.SW	2.1			
	7 a. m.				29.500	27
	9 a. m.	W.SW	3.7			
	2 p. m.				29.402	43
	3 p. m.	SW	3.6			
	9 p. m.	West	4.9		29.337	43
2	3 a. m.	West	4.0			
	7 a. m.				29.460	32
	9 a. m.	W.NW	2.7			
	2 p. m.				29.571	42
	3 p. m.	NW	0.1			
	9 p. m.	Calm	0.0		29.626	32

Date.	Hour of day.	WIND.		Height of water below zero of tide-gauge.	Barometer reduced to 62°.	Therm'r detached.
		Course.	Relative velocity.			
1863. Dec. 3	3 a. m.	S.SE	2.6			
	7 a. m.				29.450	35
	9 a. m.	S.SW	1.9			
	2 p. m.				29.261	46
	3 p. m.	S.SW	2.8			
	9 p. m.	W.SW.	3.2		29.226	47
4	3 a. m.	W.SW	3.5			
	7 a. m.				29.370	40
	9 a. m.	W.NW	2.9			
	2 p. m.				29.481	44
	3 p. m.	W.SW.	2.4			
	9 p. m.	NW	1.2		29.518	39
5	3 a. m.	N.NE	3.1			
	7 a. m.				29.720	22
	9 a. m.	North	2.5			
	2 p. m.				29.779	28
	3 p. m.	NE	1.2			
	9 p. m.	NE	0.1		29.854	26
6	3 a. m.	Calm	0.0			
	7 a. m.				29.852	27
	9 a. m.	S.SW	2.0			
	2 p. m.				29.792	38
	3 p. m.	S.SE	2.4			
	9 p. m.	S.SW	1.4		29.760	30
7	3 a. m.	S.SE	0.7			
	7 a. m.				29.734	28
	9 a. m.	S.SE	1.7			
	2 p. m.				29.612	35
	3 p. m.	S.SE	0.9			
	9 p. m.	S.SE	0.1		29.619	34
8	3 a. m.	Calm	0.0			
	7 a. m.				29.578	29
	9 a. m.	W.SW	0.7			
	2 p. m.				29.544	43
	3 p. m.	W.SW	1.3			
	9 p. m.	W.NW	1.1		29.591	40
9	3 a. m.	N.NW	0.6			
	7 a. m.				29.685	37
	9 a. m.	N. NW	0.6			
	2 p. m.				29.723	38
	3 p. m.	NE	2.4			
	9 p. m.	NE	1.4		29.727	36
10	3 a. m.	SE	2.1			
	7 a. m.				29.680	36
	9 a. m.	SE	2.8			
	2 p. m.				29.541	38
	3 p. m.	S.SE	2.8			
	9 p. m.	S.SE	2.9		29.474	38
11	3 a. m.	S.SE	1.9			
	7 a. m.				29.282	44
	9 a. m.	SW	0.7			
	2 p. m.				29.140	42
	3 p. m.	W.SW	1.4			
	9 p. m.	W.SW	0.4		29.274	39
12	3 a. m.	Calm	0.0			
	7 a. m.				29.253	35
	9 a. m.	Calm	0.0			
	2 p. m.				29.166	41
	3 p. m.	N. NE	1.8			
	9 p. m.	N. NE	4.3		29.181	40
13	3 a. m.	N.NE	5.1			
	7 a. m.				29.119	37
	9 a. m.	N. NE	6.3			
	2 p. m.				29.023	34
	3 p. m.	N. NE	7.9			
	9 p. m.	N. NE	7.7		28.915	34
14	3 a. m.	North	5.3			
	7 a. m.				28.919	24
	9 a. m.	NW	3.6			
	2 p. m.				29.093	25
	3 p. m.	NW	3.3			
	9 p. m.	NW	1.4		29.298	20

Table AA.—*Showing the wind, water, barometer, &c.*—Continued.

Date.	Hour of day.	WIND.		Heig't of water above zero of tide-gauge.	Barometer reduced to 32°.	Therm'r detached.
		Course.	Relative velocity.			
1863. Dec. 15	3 a. m.	NW	0.9			
	7 a. m.				29.555	10
	9 a. m.	NW	1.0			
	2 p. m.				29.657	7
	3 p. m.	N. NW	0.5			
	9 p. m.	NW	0.6		29.725	12
16	3 a. m.	E. NE	2.4			
	7 a. m.				29.675	26
	9 a. m.	E. NE	3.7			
	2 p. m.				29.582	29
	3 p. m.	E. NE	5.3			
	9 p. m.	E. NE	6.3		29.314	29
17	3 a. m.	E. NE	5.8			
	7 a. m.				28.961	31
	9 a. m.	E. NE	4.0			
	2 p. m.				28.858	30
	3 p. m.	S. SW	2.7			
	9 p. m.	S. SW	0.7		28.898	24
18	3 a. m.	West	0.2			
	7 a. m.				28.956	16
	9 a. m.	NW	1.6			
	2 p. m.				29.174	18
	3 p. m.	NW	2.0			
	9 p. m.	W. NW.	2.2		29.406	24
19	3 a. m.	W. NW.	2.2			
	7 a. m.				29.583	5
	9 a. m.	W. NW.	2.1			
	2 p. m.				29.642	13
	3 p. m.					
	9 p. m.				29.643	5
*20	3 a. m.					
	7 a. m.				29.604	3
	9 a. m.					
	2 p. m.				29.550	18
	3 p. m.					
	9 p. m.				29.450	17
21	3 a. m.					
	7 a. m.				29.266	22
	9 a. m.					
	2 p. m.				29.163	29
	3 p. m.	NW	1.2			
	9 p. m.	N. NW	0.7		29.317	22
22	3 a. m.	N. NW	0.5			
	7 a. m.				29.423	26
	9 a. m.	N. NW	0.9			
	2 p. m.				29.467	32
	3 p. m.	North	1.4			
	9 p. m.	N. NW	1.1		29.538	31
23	3 a. m.	N. NW	1.1			
	7 a. m.				29.607	30
	9 a. m.	E. NE	0.7			
	2 p. m.				29.628	34
	3 p. m.	E. SE	1.3			
	9 p. m.	SE.	1.7		29.649	31
24	3 a. m.	S. SW	1.3			
	7 a. m.				29.639	25
	9 a. m.	S. SW	1.7			
	2 p. m.				29.658	31
	3 p. m.	South	1.1			
	9 p. m.	South	0.4		29.556	30
25	3 a. m.	S. SE	1.0			
	7 a. m.				29.541	30
	9 a. m.	S. SE	0.9			
	2 p. m.				29.524	37
	3 p. m.	S. SE	0.9			
	9 p. m.	Calm	0.0		29.578	34
26	3 a. m.	South	0.2			
	7 a. m.				29.527	37
	9 a. m.	E. SE	1.2			
	2 p. m.				29.435	36
	3 p. m.	N. NE	1.2			
	9 p. m.	N. NE	2.8		29.496	36
1863. Dec. 27	3 a. m.	E. NE	3.5			
	7 a. m.				29.510	35
	9 a. m.	E. NE	3.5			
	2 p. m.				29.369	36
	3 p. m.	E. NE	3.5			
	9 p. m.	NE	4.7		29.134	36
28	3 a. m.	E. SE	3.7			
	7 a. m.				28.698	37
	9 a. m.	South	2.5			
	2 p. m.				28.607	35
	3 p. m.	SW	1.2			
	9 p. m.	West	4.5		28.735	30
29	3 a. m.	W. SW	3.7			
	7 a. m.				28.966	19
	9 a. m.	W. SW	3.8			
	2 p. m.				29.080	23
	3 p. m.	West	4.0			
	9 p. m.	West	2.1		29.314	15
30	3 a. m.	W. SW	1.3			
	7 a. m.				29.606	11
	9 a. m.	NW	0.6			
	2 p. m.				29.647	24
	3 p. m.	W. SW	0.4			
	9 p. m.	W. NW.	0.5		29.630	15
31	3 a. m.	N. NW	1.9			
	7 a. m.				29.380	15
	9 a. m.	NW	4.0			
	2 p. m.				29.056	15
	3 p. m.	N. NW	5.5			
	9 p. m.	NW	6.3		28.990	1
1864. Jan. 1	3 a. m.					
	7 a. m.				29.261	27
	9 a. m.					
	2 p. m.				29.361	23
	3 p. m.					
	9 p. m.	West	3.1		29.526	23
2	3 a. m.	West	3.0			
	7 a. m.				29.619	25
	9 a. m.	W. SW	2.8			
	2 p. m.				29.669	18
	3 p. m.	W. SW	1.3			
	9 p. m.	W. SW	1.3		29.636	15
3	3 a. m.	W. SW	1.1			
	7 a. m.				29.601	8
	9 a. m.	W. SW	1.8			
	2 p. m.				29.525	0
	3 p. m.	W. SW	1.3			
	9 p. m.	W. NW.	0.7		29.615	3
4	3 a. m.	Calm	0.0			
	7 a. m.				29.673	10
	9 a. m.	W. NW.	0.2			
	2 p. m.				29.576	0
	3 p. m.	NW	0.3			
	9 p. m.	NW	0.9		29,491	3
5	3 a. m.	W. NW.	1.1			
	7 a. m.				29.443	3
	9 a. m.	W. NW.	2.0			
	2 p. m.				29.528	2
	3 p. m.	W. NW.	1.4			
	9 p. m.	W. NW.	0.5		29.650	0
6	3 a. m.	W. NW.	0.1			
	7 a. m.				29.743	12
	9 a. m.	W. NW.	0.7			
	2 p. m.				29.804	0
	3 p. m.	W. NW.	0.4			
	9 p. m.	Calm	0.0		29.868	8
7	3 a. m.	Calm	0.0			
	7 a. m.				29.828	4
	9 a. m.	West	0.1			
	2 p. m.				29.800	2
	3 p. m.	W. NW.	0.1			
	9 p. m.	Calm	0.0		29.493	5

* Anemometer out of order from December 20 to 21, inclusive.

TABLE AA.—*Showing the wind, water, barometer, &c.*—Continued.

Date.	Hour of day.	WIND.		Heig't of water above zero of tide-gauge.	Barometer reduced to 32°.	Therm'r detached.	Date.	Hour of day.	WIND.		Heig't of water above zero of tide-gauge.	Barometer reduced to 32°.	Therm'r detached.
		Course.	Relative velocity.						Course.	Relative velocity.			
1864. Jan. 8	3 a. m.	W. NW.	0.5				1864. Jan. 20	3 a. m.	SW	0.3			
	7 a. m.				29.503	10		7 a. m.				29.340	18
	9 a. m.							9 a. m.	NW	0.3			
	2 p. m.				29.433	1		2 p. m.				29.455	25
	3 p. m.	W. NW.	1.0					3 p. m.	NW	0.5			
	9 p. m.	W. NW.	0.8		29.493	7		9 p. m.	N. NW	0.7		29.615	26
*9	3 a. m.						21	3 a. m.	N. NW	0.1			
	7 a. m.				29.425	4		7 a. m.				29.682	28
	9 a. m.							9 a. m.	S. SW	1.4			
	2 p. m.				29.325	13		2 p. m.				29.594	29
	3 p. m.							3 p. m.	S. SW	2.9			
	9 p. m.				29.347	11		9 p. m.	S. SW	2.4		29.542	28
10	3 a. m.						22	3 a. m.	W. SW	1.4			
	7 a. m.				29.372	5		7 a. m.				29.507	34
	9 a. m.							9 a. m.	W. SW	0.9			
	2 p. m.				29.369	14		2 p. m.				29.484	36
	3 p. m.							3 p. m.	S. SW	0.2			
	9 p. m.				29.373	7		9 p. m.	S. SW	0.1		29.474	27
11	3 a. m.						23	3 a. m.	S. SW	0.6			
	7 a. m.				29.214	2		7 a. m.				29.160	35
	9 a. m.							9 a. m.	SW	2.1			
	2 p. m.					21		2 p. m.				29.075	42
	3 p. m.							3 p. m.	W. SW	1.4			
	9 p. m.				29.106	15		9 p. m.	W. SW	0.8		29.152	38
12	3 a. m.						24	3 a. m.	W. SW	1.5			
	7 a. m.				29.003	21		7 a. m.				29.060	36
	9 a. m.							9 a. m.	West	1.5			
	2 p. m.				28.877	31		2 p. m.				29.007	46
	3 p. m.							3 p. m.	W. SW	1.9			
	9 p. m.				28.925	25		9 p. m.	W. SW	2.1		29.007	39
13	3 a. m.						25	3 a. m.	W. SW	0.5			
	7 a. m.				28.970	26		7 a. m.				29.152	35
	9 a. m.							9 a. m.	W. SW	0.5			
	2 p. m.				29.003	28		2 p. m.				28.967	44
	3 p. m.							3 p. m.	S. SW	2.9			
	9 p. m.				29.037	28		9 p. m.	West	3.8		28.952	44
14	3 a. m.						26	3 a. m.	W. SW	0.7			
	7 a. m.				28.985	34		7 a. m.				29.238	34
	9 a. m.							9 a. m.	W. SW	0.3			
	2 p. m.				29.078	30		2 p. m.				29.177	43
	3 p. m.							3 p. m.	S. SW	1.7			
	9 p. m.				29.213	23		9 p. m.	West	3.5		29.084	44
15	3 a. m.						27	3 a. m.	W. SW	1.2			
	7 a. m.				29.356	18		7 a. m.				29.139	37
	9 a. m.							9 a. m.	W. SW	0.1			
	2 p. m.				29.363	26		2 p. m.				29.162	48
	3 p. m.							3 p. m.	Calm	0.0			
	9 p. m.				29.388	15		9 p. m.	Calm	0.0		29.226	35
16	3 a. m.						28	3 a. m.	Calm	0.0			
	7 a. m.				29.303	15		7 a. m.				29.236	32
	9 a. m.							9 a. m.	North	0.7			
	2 p. m.				29.252	33		2 p. m.				29.404	37
	3 p. m.							3 p. m.	N. NE	6.4			
	9 p. m.				29.185	34		9 p. m.	N. NE	7.0		29.550	36
17	3 a. m.						29	3 a. m.	N. NE	4.5			
	7 a. m.				29.167	34		7 a. m.				29.498	34
	9 a. m.							9 a. m.	NE	3.5			
	2 p. m.				29.377	32		2 p. m.				29.387	34
	3 p. m.							3 p. m.	N. NE	2.7			
	9 p. m.				29.542	26		9 p. m.	NE	3.7		29.395	32
18	3 a. m.						30	3 a. m.	E. NE	2.1			
	7 a. m.				29.564	22		7 a. m.				29.198	33
	9 a. m.							9 a. m.	NE	0.8			
	2 p. m.				29.510	28		2 p. m.				29.306	35
	3 p. m.	N. NW	3.0					3 p. m.	Calm	0.0			
	9 p. m.	N. NW	2.6		29.511	19		9 p. m.	Calm	0.0		29.432	35
19	3 a. m.	NW	1.8				31	3 a. m.	Calm	0.0			
	7 a. m.				29.424	17		7 a. m.				29.534	34
	9 a. m.	W. NW.	1.2					9 a. m.	E. NE	0.1			
	2 p. m.				29.303	22		2 p. m.				29.354	30
	3 p. m.	West	0.7					3 p. m.	E. NE	2.0			
	9 p. m.	SW	0.1		29.295	21		9 p. m.	NE	4.1		28.942	36

* Anemometer out of order from January 9 to 18, inclusive.

TABLE AA.—*Showing the wind, water, barometer, &c.*—Continued.

Date.	Hour of day.	WIND.		Heig't of water above zero of tide-gauge.	Barometer reduced to 32°.	Therm'r detached.
		Course.	Relative velocity.			
1864.						
Feb. 1	3 a. m.	W. NW.	4.8	......	......	...
	7 a. m.	......	...	......	29.040	33
	9 a. m.	W. SW.	4.0	......	......	...
	2 p. m.	......	...	......	29.237	34
	3 p. m.	W. SW.	3.3	......	......	...
	9 p. m.	W. SW.	1.7	......	29.291	27
2	3 a. m.	W. SW.	2.2	......	......	...
	7 a. m.	......	...	......	29.165	25
	9 a. m.	West...	3.0	......	......	...
	2 p. m.	......	...	......	29.220	24
	3 p. m.	W. NW.	3.4	......	......	...
	9 p. m.	W. NW.	1.4	......	29.372	23
3	3 a. m.	W. SW.	0.4	......	......	...
	7 a. m.	......	...	......	29.360	14
	9 a. m.	W. SW.	0.4	......	......	...
	2 p. m.	......	...	......	29.195	29
	3 p. m.	S. SW.	0.5	......	......	...
	9 p. m.	S. SW.	2.1	......	28.867	33
4	3 a. m.	W. SW.	2.6	......	......	...
	7 a. m.	......	...	......	28.637	35
	9 a. m.	NW....	2.7	......	......	...
	2 p. m.	......	...	......	28.833	33
	3 p. m.	NW....	1.9	......	......	...
	9 p. m.	W. NW.	0.3	......	29.005	32
5	3 a. m.	S. SW.	0.1	......	......	...
	7 a. m.	......	...	......	28.810	35
	9 a. m.	S. SW.	0.1	......	......	...
	2 p. m.	......	...	......	28.782	37
	3 p. m.	Calm...	0.0	......	......	...
	9 p. m.	NE....	0.5	......	29.017	35
6	3 a. m.	N. NW.	3.0	......	......	...
	7 a. m.	......	...	......	29.275	30
	9 a. m.	N. NW.	1.7	......	......	...
	2 p. m.	......	...	......	29.312	34
	3 p. m.	W. NW.	0.4	......	......	...
	9 p. m.	Calm...	0.0	......	29.264	23
7	3 a. m.	SW....	2.3	......	......	...
	7 a. m.	......	...	......	28.960	29
	9 a. m.	S. SW.	2.5	......	......	...
	2 p. m.	......	...	......	28.820	37
	3 p. m.	W. NW.	2.6	......	......	...
	9 p. m.	W. NW.	2.3	......	28.965	31
8	3 a. m.	NW....	0.5	......	......	...
	7 a. m.	......	...	......	29.113	22
	9 a. m.	W. NW.	1.7	......	......	...
	2 p. m.	......	...	......	29.195	22
	3 p. m.	W. NW.	2.5	......	......	...
	9 p. m.	W. NW.	0.9	......	29.340	16
9	3 a. m.	W. SW.	0.8	......	......	...
	7 a. m.	......	...	......	29.443	6
	9 a. m.	W. NW.	2.0	......	......	...
	2 p. m.	......	...	......	29.486	13
	3 p. m.	NW....	1.0	......	......	...
	9 p. m.	NW....	0.2	......	29.581	6
10	3 a. m.	NW....	0.1	......	......	...
	7 a. m.	......	...	......	29.667	3
	9 a. m.	Calm...	0.0	......	......	...
	2 p. m.	......	...	......	29.596	27
	3 p. m.	S. SE..	1.0	......	......	...
	9 p. m.	S. SE..	1.7	......	29.485	25
11	3 a. m.	South..	1.2	......	......	...
	7 a. m.	......	...	......	29.268	32
	9 a. m.	S. SW.	1.6	......	......	...
	2 p. m.	......	...	......	29.173	40
	3 p. m.	W. NW.	1.6	......	......	...
	9 p. m.	W. NW.	0.8	......	29.340	32
12	3 a. m.	W. SW.	0.7	......	......	...
	7 a. m.	......	...	......	29.407	24
	9 a. m.	W. NW.	1.4	......	......	...
	2 p. m.	......	...	......	29.367	28
	3 p. m.	W. SW.	2.3	......	......	...
	9 p. m.	W. SW.	3.7	......	29.244	27
1864.						
Feb. 13	3 a. m.	W. SW.	2.9	......	......	...
	7 a. m.	......	...	......	29.115	32
	9 a. m.	SW....	1.4	......	......	...
	2 p. m.	......	...	......	28.910	41
	3 p. m.	S. SW.	1.6	......	......	...
	9 p. m.	West...	2.7	......	28.935	35
14	3 a. m.	W. NW.	2.7	......	......	...
	7 a. m.	......	...	......	29.327	29
	9 a. m.	NW....	0.6	......	......	...
	2 p. m.	......	...	......	29.432	28
	3 p. m.	Calm...	0.0	......	......	...
	9 p. m.	Calm...	0.0	......	29.367	29
15	3 a. m.	S. SW.	1.1	......	......	...
	7 a. m.	......	...	......	29.107	33
	9 a. m.	West...	3.3	......	......	...
	2 p. m.	......	...	......	29.055	35
	3 p. m.	West...	5.4	......	......	...
	9 p. m.	W. NW.	6.5	......	29.133	29
16	3 a. m.	W. NW.	6.1	......	......	...
	7 a. m.	......	...	......	29.433	13
	9 a. m.	W. NW.	5.7	......	......	...
	2 p. m.	......	...	......	29.457	8
	3 p. m.	W. NW.	4.6	......	......	...
	9 p. m.	W. NW.	1.7	......	29.549	11
17	3 a. m.	NW....	1.2	......	......	...
	7 a. m.	......	...	......	29.722	16
	9 a. m.	W. NW.	2.0	......	......	...
	2 p. m.	......	...	......	29.762	8
	3 p. m.	West..	2.5	......	......	...
	9 p. m.	W. SW.	0.6	......	29.784	12
18	3 a. m.	W. SW.	0.5	......	......	...
	7 a. m.	......	...	......	29.788	10
	9 a. m.	W. NW.	1.4	......	......	...
	2 p. m.	......	...	......	29.862	0
	3 p. m.	W. NW.	1.5	......	......	...
	9 p. m.	SW....	0.1	......	29.913	1
19	3 a. m.	S. SW..	0.2	......	......	...
	7 a. m.	......	...	......	29.766	3
	9 a. m.	S. SW..	3.3	......	......	...
	2 p. m.	......	...	......	29.349	25
	3 p. m.	S. SW..	4.3	......	......	...
	9 p. m.	S. SW..	2.2	......	29.301	27
20	3 a. m.	S. SW..	0.8	......	......	...
	7 a. m.	......	...	......	29.253	26
	9 a. m.	S. SW..	2.2	......	......	...
	2 p. m.	......	...	......	29.080	42
	3 p. m.	S. SW..	2.2	......	......	...
	9 p. m.	S. SW..	1.3	......	28.873	38
21	3 a. m.	W. NW.	0.6	......	......	...
	7 a. m.	......	...	......	29.117	38
	9 a. m.	SW....	0.1	......	......	...
	2 p. m.	......	...	......	29.142	41
	3 p. m.	S. SW.	0.3	......	......	...
	9 p. m.	S. SW..	0.4	......	29.047	38
22	3 a. m.	SW....	0.8	......	......	...
	7 a. m.	......	...	......	28.972	38
	9 a. m.	W. NW.	1.7	......	......	...
	2 p. m.	......	...	......	29.075	46
	3 p. m.	SW....	1.3	......	......	...
	9 p. m.	SW....	0.5	......	29.119	42
23	3 a. m.	SW....	1.2	......	......	...
	7 a. m.	......	...	......	28.969	43
	9 a. m.	West...	3.1	......	......	...
	2 p. m.	......	...	......	28.967	48
	3 p. m.	West...	3.3	......	......	...
	9 p. m.	W. SW.	1.6	......	29.117	41
24	3 a. m.	NW....	1.0	......	......	...
	7 a. m.	......	...	......	89.316	36
	9 a. m.	West...	1.6	......	......	...
	2 p. m.	......	...	......	29.301	45
	3 p. m.	West...	1.0	......	......	...
	9 p. m.	SE.....	0.4	......	29.193	42

TABLE AA.—*Showing the wind, water, barometer, &c.*—Continued.

Date.	Hour of day.	WIND.		Heig't of water above zero of tide-gauge.	Barometer reduced to 32°.	Therm'r detached.
		Course.	Relative velocity.			
1864.						
Feb. 25	3 a. m.	West	2.3	......	......	...
	7 a. m.	......	...	......	29.002	38
	9 a. m.	West	3.6	......	......	...
	2 p. m.	......	...	......	29.292	36
	3 p. m.	North	4.6	......	......	...
	9 p. m.	N. NW.	0.1	......	29.519	33
26	3 a. m.	N. NW.	0.1	......	......	...
	7 a. m.	......	...	......	29.587	30
	9 a. m.	E. SE	0.8	......	......	...
	2 p. m.	......	...	......	29.411	36
	3 p. m.	SE	2.2	......	......	...
	9 p. m.	SE	1.5	......	29.336	38
27	3 a. m.	S. SE	1.2	......	......	...
	7 a. m.	......	...	......	29.191	38
	9 a. m.	S. SE	1.0	......	......	...
	2 p. m.	......	...	......	29.095	39
	3 p. m.	W. SW.	0.9	......	......	...
	9 p. m.	W. SW.	2.6	......	29.195	36
28	3 a. m.	West	3.9	......	......	...
	7 a. m.	......	...	......	29.407	21
	9 a. m.	West	4.8	......	......	...
	2 p. m.	......	...	......	29.425	21
	3 p. m.	West	4.1	......	......	...
	9 p m.	W. NW.	2.9	......	29.528	17
29	3 a. m.	W. NW.	1.1	......	......	...
	7 a. m.	......	...	......	29.633	11
	9 a. m.	W. NW.	0.6	......	......	...
	2 p. m.	......	...	......	29.601	24
	3 p. m.	SW	0.8	......	......	...
	9 p. m.	Calm	0.0	......	29.575	22
March 1	3 a. m.	S. SW	0.2	......	......	...
	7 a. m.	......	...	......	29.400	25
	9 a. m.	SW	1.2	......	......	...
	2 p. m.	......	...	......	29.292	37
	3 p. m.	West	3.1	......	......	...
	9 p. m.	West	1.8	......	29.382	32
2	3 a. m.	W. NW.	0.8	......	......	...
	7 a. m.	......	...	......	29.568	23
	9 a. m.	NW	0.6	......	......	...
	2 p. m.	......	...	......	29.592	31
	3 p. m.	E. SE	1.6	......	......	...
	9 p. m.	S. SE	0.3	......	29.517	31
3	3 a. m.	South	0.5	......	......	...
	7 a. m.	......	...	......	29.387	35
	9 a. m.	South	3.0	......	......	...
	2 p. m.	......	...	......	29.196	52
	3 p. m.	South	4.3	......	......	...
	9 p. m.	S. SW	2.2	......	29.129	43
4	3 a. m.	S. SW	0.6	......	......	...
	7 a. m.	......	...	......	28.987	39
	9 a. m.	W. NW.	0.6	......	......	...
	2 p. m.	......	...	......	29.007	34
	3 p. m.	North	1.9	......	......	...
	9 p. m.	NW	1.7	......	29.165	27
5	3 a. m.	N. NW.	0.7	......	......	...
	7 a. m.	......	...	......	29.210	17
	9 a. m.	NW	0.1	......	......	...
	2 p. m.	......	...	......	29.160	35
	3 p. m.	Calm	0.0	......	......	...
	9 p. m.	Calm	0.0	......	29.155	30
6	3 a. m.	Calm	0.0	......	......	...
	7 a. m.	......	...	......	29.067	33
	9 a. m.	SE	0.4	......	......	...
	2 p m.	......	...	......	29.057	40
	3 p. m.	S. SE	0.7	......	......	...
	9 p. m.	E. NE	0.2	......	29.125	35
7	3 a. m.	N. NW.	0.5	......	......	...
	7 a. m.	......	...	......	29.157	34
	9 a. m.	North	1.7	......	......	...
	2 p. m.	......	...	......	29.142	38
	3 p. m.	N. NE	2.8	......	......	...
	9 p. m.	Calm	0.0	......	29.195	35
1864.						
March 8	3 a. m.	N. NW.	0.3	......	......	...
	7 a. m.	......	...	......	29.215	30
	9 a. m.	N. NE	1.2	......	......	...
	2 p. m.	......	...	......	29.270	38
	3 p. m.	NE	0.8	......	......	...
	9 p. m.	Calm	0.0	......	29.322	35
9	3 a. m.	Calm	0.0	......	......	...
	7 a. m.	......	...	......	29.332	37
	9 a. m.	E. SE	0.5	......	......	...
	2 p. m.	......	...	......	29.237	37
	3 p. m.	E. NE	3.0	......	......	...
	9 p. m.	NE	2.6	......	29.152	37
10	3 a. m.	NE	1.7	......	......	...
	7 a. m.	......	...	......	28.910	36
	9 a. m.	N. NE	2.9	......	......	...
	2 p. m.	......	...	......	28.867	37
	3 p. m.	North	0.6	......	......	...
	9 p. m.	N. NE	2.0	......	28.807	35
11	3 a. m.	NW	0.4	......	......	...
	7 a. m.	......	...	......	28.697	32
	9 a. m.	NW	0.1	......	......	...
	2 p. m.	......	...	......	28.737	35
	3 p. m.	W. NW.	0.6	......	......	...
	9 p. m.	Calm	0.0	......	28.917	35
12	3 a. m.	Calm	0.0	......	......	...
	7 a. m.	......	...	......	29.102	34
	9 a. m.	Calm	0.0	......	......	...
	2 p. m.	......	...	......	29.160	35
	3 p. m.	NE	0.6	......	......	...
	9 p. m.	NE	0.6	......	29.274	34
13	3 a. m.	N. NE	3.0	......	......	...
	7 a. m.	......	...	......	29.358	31
	9 a. m.	N. NE	2.5	......	......	...
	2 p. m.	......	...	......	29.418	34
	3 p. m.	NE	1.0	......	......	...
	9 p. m.	Calm	0.0	......	29.470	32
14	3 a. m.	W. NW.	2.2	......	......	...
	7 a. m.	......	...	......	29.508	25
	9 a. m.	NW	3.5	......	......	...
	2 p. m.	......	...	......	29.538	25
	3 p. m.	NW	3.1	......	......	...
	9 p. m.	N. NW.	0.9	......	29.598	24
15	3 a. m.	N. NW.	2.3	......	......	...
	7 a. m.	......	...	......	29.591	16
	9 a. m.	N. NW.	3.1	......	......	...
	2 p. m.	......	...	......	29.581	24
	3 p. m.	NW	1.7	......	......	...
	9 p. m.	W. SW	0.8	......	29.559	21
16	3 a. m.	W. NW.	1.4	......	......	...
	7 a. m.	......	...	......	29.471	20
	9 a. m.	West	2.1	......	......	...
	2 p. m.	......	...	......	29.345	37
	3 p. m.	West	2.9	......	......	...
	9 p. m.	SW	0.4	......	29.268	34
17	3 a. m.	SW	0.8	......	......	...
	7 a. m.	......	...	......	29.093	32
	9 a. m.	W. SW.	2.4	......	......	...
	2 p. m.	......	...	......	28.917	40
	3 p. m.	W. SW.	2.7	......	......	...
	9 p. m.	S. SW	3.9	......	28.747	38
18	3 a. m.	W. NW.	4.7	......	......	...
	7 a. m.	......	...	......	28.931	15
	9 a. m.	W. NW.	4.7	......	......	...
	2 p. m.	......	...	......	29.094	14
	3 p. m.	W. NW.	4.3	......	......	...
	9 p. m.	W. NW.	2.8	......	29.214	13
19	3 a. m.	W. NW.	0.7	......	......	...
	7 a. m.	......	...	......	29.217	11
	9 a. m.	W. NW.	3.6	......	......	...
	2 p. m.	......	...	......	29.260	11
	3 p. m.	W. NW.	3.9	......	......	...
	9 p. m.	W. NW.	1.0	......	39.292	10

TABLE AA.—*Showing the wind, water, barometer, &c.*—Continued.

Date.	Hour of day.	WIND.		Heig't of water above zero of tide-gauge.	Barometer reduced to 32°.	Therm'r detached.
		Course.	Relative velocity.			
1864. Mar. 20	3 a. m.	W. NW.	1.8			
	7 a. m.				29.398	2
	9 a. m.	NW	3.3			
	2 p. m.				29.446	9
	3 p. m.	W. NW.	3.0			
	9 p. m.	W. NW.	0.4		29.468	8
21	3 a. m.	W. NW.	0.7			
	7 a. m.				29.533	10
	9 a. m.	W. NW.	1.3			
	2 p. m.				29.535	20
	3 p. m.	N. NW	1.2			
	9 p. m.	NW	0.4		29.632	16
22	3 a. m.	NE	1.2			
	7 a. m.				29.664	21
	9 a. m.	E. NE	1.4			
	2 p. m.				29.641	26
	3 p. m.	NE	1.1			
	9 p. m.	Calm	0.0		29.585	20
23	3 a. m.	NW	0.3			
	7 a. m.				29.578	19
	9 a. m.	E. SE	0.6			
	2 p. m.				29.538	33
	3 p. m.	SE	2.1			
	9 p. m.	South	0.1		29.500	29
24	3 a. m.	S. SW	0.1			
	7 a. m.				29.472	38
	9 a. m.	S. SW	1.8			
	2 p. m.				29.324	44
	3 p. m.	SE	2.0			
	9 p. m.	SE	0.4		29.249	37
25	3 a. m.	Calm	0.0			
	7 a. m.				29.030	34
	9 a. m.	E. SE	0.2			
	2 p. m.				28.940	42
	3 p. m.	SE	0.2			
	9 p. m.	Calm	0.0		29.045	34
26	3 a. m.	Calm	0.0			
	7 a. m.				29.262	35
	9 a. m.	N. NE	1.7			
	2 p. m.				29.452	37
	3 p. m.	E. NE	0.1			
	9 p. m.	N. NW	0.3		29.394	34
27	3 a. m.	N. NE	1.8			
	7 a. m.				29.494	32
	9 a. m.	N. NE	2.7			
	2 p. m.				29.414	35
	3 p. m.	N. NE	2.7			
	9 p. m.	N. NE	2.1		29.182	37
28	3 a. m.	E. SE	1.7			
	7 a. m.				28.897	42
	9 a. m.	E. SE	2.0			
	2 p. m.				22.689	42
	3 p. m.	E. SE	1.3			
	9 p. m.	SW	0.2		28.677	40
29	3 a. m.	E. SE	0.2			
	7 a. m.				28.741	37
	9 a. m.	E. SE	1.4			
	2 p. m.				28.784	42
	3 p. m.	E. SE	1.2			
	9 p. m.	N. NE	0.1		28.882	45
30	3 a. m.	W. NW.	0.7			
	7 a. m.				28.932	36
	9 a. m.	N. NW	1.7			
	2 p. m.				28.977	37
	3 p. m.	N. NE	2.4			
	9 p. m.	N. NE	0.9		29.075	36
31	3 a. m.	N. NW	0.6			
	7 a. m.				29.067	35
	9 a. m.	N. NE	1.4			
	2 p. m.				29.117	40
	3 p. m.	NE	0.8			
	9 p. m.	Calm	0.0		29.155	35
1864. April 1	3 a. m.	N. NE	0.8	4.32		
	7 a. m.				29.145	35
	9 a. m.	N. NE	1.1	4.34		
	2 p. m.				29.077	41
	3 p. m.	NE	0.8	4.32		
	9 p. m.	Calm	0.0	4.25	29.112	37
2	3 a. m.	Calm	0.0	4.32		
	7 a. m.				29.092	38
	9 a. m.	NW	1.0	4.31		
	2 p. m.				29.137	42
	3 p. m.	E. SE	0.4	4.32		
	9 p. m.	Calm	0.0	4.29	29.233	38
3	3 a. m.	Calm	0.0	4.31		
	7 a. m.				29.318	38
	9 a. m.	N. NE	0.6	4.29		
	2 p. m.				29.318	42
	3 p. m.	NE	1.9	4.29		
	9 p. m.	N. NE	1.2	4.18	29.306	36
4	3 a. m.	N. NE	1.8	4.16		
	7 a. m.				29.132	37
	9 a. m.	North	4.1	4.12		
	2 p. m.				29.067	37
	3 p. m.	North	4.9	4.06		
	9 p. m.	N. NW	3.2	4.10	29.107	38
5	3 a. m.	N. NW	1.7	4.10		
	7 a. m.				29.197	38
	9 a. m.	N. NW	1.9	4.13		
	2 p. m.				29.202	41
	3 p. m.	N. NE	1.0	4.15		
	9 p. m.	North	0.4	4.16	29.409	38
6	3 a. m.	N. NE	1.4	4.19		
	7 a. m.				29.524	36
	9 a. m.	NE	2.0	4.19		
	2 p. m.				29.514	35
	3 p. m.	N. NE	2.5	4.16		
	9 p. m.	N. NE	1.3	4.14	29.497	35
7	3 a. m.	East	0.1	4.05		
	7 a. m.				29.392	39
	9 a. m.	E. SE	0.1	4.09		
	2 p. m.				29.291	44
	3 p. m.	NE	0.3	3.98		
	9 p. m.	N. NE	1.7	3.84	29.321	39
8	3 a. m.	N. NE	2.0	3.91		
	7 a. m.				29.245	39
	9 a. m.	N. NE	3.5	3.88		
	2 p. m.				29.097	42
	3 p. m.	N. NE	3.3	3.75		
	9 p. m.	NE	1.9	3.74	29.060	41
9	3 a. m.	N. NE	2.1	3.80		
	7 a. m.				29.077	38
	9 a. m.	N. NE	3.4	3.91		
	2 p. m.				29 062	39
	3 p. m.	North	4.0	3.85		
	9 p. m.	N. NW	1.9	3.90	29.087	37
10	3 a. m.	NW	1.0	3.97		
	7 a. m.				29.090	37
	9 a. m.	NW	1.9	4.10		
	2 p. m.				29.152	45
	3 p. m.	North	0.3	4.09		
	9 p. m.	Calm	0.0	4.11	29.224	38
11	3 a. m.	Calm	0.0	4.12		
	7 a. m.				29.275	35
	9 a. m.			4.21		
	2 p. m.				29.225	40
	3 p. m.	NE	0.2	4.13		
	9 p. m.	W. NW.	0.1	4.10	29.204	41
12	3 a. m.	Calm	0.0	4.03		
	7 a. m.				29.190	41
	9 a. m.	West	0.5	4.01		
	2 p. m.				29.208	45
	3 p. m.	W. NW.	2.9	3.96		
	9 p. m.	NW	1.2	3.94	29.274	40

TABLE AA.—*Showing the wind, water, barometer, &c.*—Continued.

Date.	Hour of day.	Wind.		Heig't of water above zero of tide-gauge.	Barometer reduced to 32°.	Therm'r detached.
		Course.	Relative velocity.			
1864. April 13	3 a. m.	N.NW	1.0	4.02	...	...
	7 a. m.	...	...	...	29.359	39
	9 a. m.	W.NW	1.9	4.11	...	...
	2 p. m.	...	...	...	29.371	48
	3 p. m.	W.NW	1.6	4.13	...	...
	9 p. m.	Calm	0.0	4.12	29.408	41
14	3 a. m.	NE	0.1	4.12	...	...
	7 a. m.	...	...	...	29.398	37
	9 a. m.	N.NE	1.3	4.11	...	...
	2 p. m.	...	...	...	29.394	41
	3 p. m.	N.NE	2.7	4.08	...	...
	9 p. m.	North	1.7	3.94	29.369	36
15	3 a. m.	N.NE	2.5	3.99	...	...
	7 a. m.	...	...	...	29.340	33
	9 a. m.	N.NE	2.8	3.96	...	...
	2 p. m.	...	...	...	29.257	39
	3 p. m.	N.NE	1.5	4.02	...	...
	9 p. m.	N.NE	1.2	3.98	29.259	36
16	3 a. m.	N.NE	1.2	4.00	...	...
	7 a. m.	...	...	...	29.230	34
	9 a. m.	N.NW	0.6	4.01	...	...
	2 p. m.	...	...	...	29.224	39
	3 p. m.	E.NE	0.1	4.07	...	...
	9 p. m.	Calm	0.0	4.01	29.284	33
17	3 a. m.	Calm	0.0	4.11	...	...
	7 a. m.	...	...	...	29.299	35
	9 a. m.	SW	0.8	4.09	...	...
	2 p. m.	...	...	...	29.274	46
	3 p. m.	E.SE	0.3	4.13	...	...
	9 p. m.	Calm	0.0	4.06	29.366	40
18	3 a. m.	Calm	0.0	4.11	...	...
	7 a. m.	...	...	...	29.394	38
	9 a. m.	N.NE	1.4	4.03	...	...
	2 p. m.	...	...	...	29.464	43
	3 p. m.	NE	0.9	4.05	...	...
	9 p. m.	Calm	0.0	3.96	29.536	36
19	3 a. m.	Calm	0.0	4.00	...	...
	7 a. m.	...	...	...	29.599	37
	9 a. m.	N.NE	1.7	3.96	...	...
	2 p. m.	...	...	...	29.556	45
	3 p. m.	N NE	2.0	4.03	...	...
	9 p. m.	Calm	0.0	3.92	29.491	37
20	3 a. m.	Calm	0.0	3.96	...	...
	7 a. m.	...	...	...	29.466	40
	9 a. m.	E.SE	0.4	3.96	...	...
	2 p. m.	...	...	...	29.383	46
	3 p. m.	E.SE	0.7	4.00	...	...
	9 p. m.	Calm	0.0	2.93	29.361	41
21	3 a. m.	Calm	0.0	3.97	...	...
	7 a. m.	...	...	...	29.356	44
	9 a. m.	E.SE	1.0	3.96	...	...
	2 p. m.	...	...	...	29.301	49
	3 p. m.	E.SE	1.5	3.93	...	...
	9 p. m.	E.SE	0.2	3.85	29.271	44
22	3 a. m.	N.NE	0.2	3.84	...	...
	7 a. m.	...	...	...	29.201	43
	9 a. m.	Calm	0.0	3.84	...	...
	2 p. m.	...	...	...	29.203	52
	3 p. m.	Calm	0.0	3.82	...	...
	9 p. m.	NE	0.1	3.81	29.298	47
23	3 a. m.	North	2.9	3.81	...	...
	7 a. m.	...	...	...	29.418	39
	9 a. m.	North	5.4	3.90	...	...
	2 p. m.	...	...	...	29.446	41
	3 p. m.	N.NE	4.2	3.94	...	...
	9 p. m.	N.NE	1.6	3.92	29.457	37
24	3 a. m.	NE	1.7	3.80	...	...
	7 a. m.	...	...	...	29.332	38
	9 a. m.	N.NE	4.1	3.81	...	...
	2 p. m.	...	...	...	29.217	36
	3 p. m.	N.NE	5.3	3.66	...	...
	9 p. m.	N.NE	3.0	3.61	29.195	38
1864. April 25	3 a. m.	North	1.8	3.65	...	...
	7 a. m.	...	...	...	29.175	41
	9 a. m.	N.NW	0.5	3.81	...	...
	2 p. m.	...	...	...	29.177	47
	3 p. m.	N.NW	1.6	3.78	...	...
	9 p. m.	NW	0.2	3.88	29.271	43
26	3 a. m.	Calm	0.0	3.88	...	...
	7 a. m.	...	...	...	29.339	48
	9 a. m.	E.SE	0.9	3.93	...	...
	2 p. m.	...	...	...	29.291	52
	3 p. m.	E.SE	1.8	3.82	...	...
	9 p. m.	North	6.2	3.76	29.280	61
27	3 a. m.	North	3.1	3.65	...	...
	7 a. m.	...	...	...	29.582	36
	9 a. m.	N.NE	6.6	3.66	...	...
	2 p. m.	...	...	...	29.600	38
	3 p. m.	N.NE	7.0	3.66	...	...
	9 p. m.	N.NE	5.4	3.63	29.585	36
28	3 a. m.	N.NE	1.7	3.64	...	...
	7 a. m.	...	...	...	29.650	38
	9 a. m.	NE	2.2	3.69	...	...
	2 p. m.	...	...	...	29.622	42
	3 p. m.	N.NE	2.9	3.69	...	...
	9 p. m.	N.NE	2.1	3.63	29.634	36
29	3 a. m.	E.SE	0.5	3.70	...	...
	7 a. m.	...	...	...	29.637	39
	9 a. m.	E.SE	1.4	3.70	...	...
	2 p. m.	...	...	...	29.594	42
	3 p. m.	N.NE	2.1	3.75	...	...
	9 p. m.	North	2.5	3.69	29.539	39
30	3 a. m.	North	2.0	3.69	...	...
	7 a. m.	...	...	...	29.422	38
	9 a. m.	N.NE	0.7	3.70	...	...
	2 p. m.	...	...	...	29.389	44
	3 p. m.	NE	0.7	3.81	...	...
	9 p. m.	S.SW	0.5	...	29.346	40
May 1	3 a. m.	S.SW	0.6	...	...	...
	7 a. m.	...	...	...	29.184	45
	9 a. m.	West	3.5	...	...	...
	2 p. m.	...	...	...	29.156	49
	3 p. m.	W.NW	4.1	3.59	...	...
	9 p. m.	Calm	0.0	3.51	29.187	39
2	3 a. m.	Calm	0.0	3.63	...	...
	7 a. m.	...	...	...	29.204	36
	9 a. m.	...	...	3.56	...	...
	2 p. m.	...	...	...	29.341	41
	3 p. m.	Calm	0.0	3.55	...	...
	9 p. m.	Calm	0.0	3.58	29.331	36
3	3 a. m.	W.NW	0.2	3.73	...	...
	7 a. m.	...	...	...	29.373	38
	9 a. m.	NW	1.2	3.69	...	...
	2 p. m.	...	...	...	29.366	47
	3 p. m.	E.SE	1.3	3.71	...	...
	9 p. m.	Calm	0.0	3.68	29.407	40
4	3 a. m.	S.SW	0.3	3.68	...	...
	7 a. m.	...	...	...	29.416	49
	9 a. m.	SE	2.2	3.51	...	...
	2 p. m.	...	...	...	29.435	56
	3 p. m.	S.SE	1.6	3.52	...	...
	9 p. m.	S.SE	0.9	3.55	29.300	52
5	3 a. m.	S.SW	0.9	3.43	...	...
	7 a. m.	...	...	...	29.325	58
	9 a. m.	S.SW	2.7	3.46	...	...
	2 p. m.	...	...	...	29.909	79
	3 p. m.	S.SW	4.2	3.46	...	...
	9 p. m.	W.SW	3.0	3.43	29.224	69
6	3 a. m.	N.NE	2.0	...	...	...
	7 a. m.	...	...	...	29.367	39
	9 a. m.	N.NE	4.8	3.40	...	...
	2 p. m.	...	...	...	29.423	41
	3 p. m.	N.NE	3.0	3.40	...	...
	9 p. m.	N.NE	1.6	3.46	29.386	40

TABLE AA.—*Showing the wind, water, barometer, &c.*—Continued.

Date.	Hour of day.	WIND.		Heig't of water above zero of tide-gauge.	Barometer reduced to 32°.	Therm'r detached.	Date.	Hour of day.	WIND.		Heig't of water above zero of tide-gauge.	Barometer reduced to 32°.	Therm'r detached.
		Course.	Relative velocity.						Course.	Relative velocity.			
1864. May 7	3 a. m.	North	0.6	3.38			1864. May 19	3 a. m.	Calm	0.0	3.45		
	7 a. m.				29.276	42		7 a. m.				29.379	63
	9 a. m.	NE	1.4	3.32				9 a. m.	W.SW	0.4	3.42		
	2 p. m.				29.213	42		2 p. m.				29.336	65
	3 p. m.	NE	1.0	3.27				3 p. m.	E.SE	0.6	3.43		
	9 p. m.	N.NE	0.8	8.42	29.207	41		9 p. m.	Calm	0.0		29.363	58
8	3 a. m.	N.NE	0.6	3.31			20	3 a. m.	Calm	0.0	3.48		
	7 a. m.				29.196	42		7 a. m.				29.341	65
	9 a. m.	N.NE	1.6	3.39				9 a. m.	W.NW	1.7	3.52		
	2 p. m.				29.218	50		2 p. m.				29.273	88
	3 p. m.	NE	0.2	3.40				3 p. m.	West	1.8	3.49		
	9 p. m.	Calm	0.0	3.66	29.179	44		9 p. m.	W.SW	0.5	3.51	29.225	74
9	3 a. m.	SW	0.9	3.47			21	3 a. m.	W.SW	1.2	3.56		
	7 a. m.				29.156	54		7 a. m.				29.253	75
	9 a. m.	SW	1.4	3.57				9 a. m.	W.SW	3.0	3.58		
	2 p. m.				29.016	70		2 p. m.				29.175	88
	3 p. m.	S.SW	2.5	3.52				3 p. m.	W.SW	3.0	3.52		
	9 p. m.	S.SW	5.6	3.19	29.983	62		9 p. m.	W.SW	0.7	3.50	29.165	76
10	3 a. m.	N.NE	9.2	3.12			22	3 a. m.	N.NE	0.6	3.32		
	7 a. m.				29.277	34		7 a. m.				29.278	55
	9 a. m.	N.NE	7.2					9 a. m.	NE	1.4	3.28		
	2 p. m.				29.355	38		2 p. m.				29.241	60
	3 p. m.	N.NE	4.0					3 p. m.	NE	0.1	3.19		
	9 p. m.	N.NE	0.7		29.377	34		9 p. m.	Calm	0.0	3.17	29.146	51
11	3 a. m.	Calm	0.0				23	3 a. m.	Calm	0.0	3.16		
	7 a. m.				29.374	38		7 a. m.				29.065	70
	9 a. m.	SE	1.2					9 a. m.	W.SW	2.9	3.31		
	2 p. m.				29.256	47		2 p. m.				29.062	78
	3 p. m.	E.SE	2.3					3 p. m.	W.SW	4.2	3.33		
	9 p. m.	SE	0.6		29.189	47		9 p. m.	W.SW	0.9	3.40	29.135	64
12	3 a. m.	S.SW	1.0				24	3 a. m.	Calm	0.0	3.36		
	7 a. m.				29.084	53		7 a. m.				29.115	60
	9 a. m.	N.NE	1.6					9 a. m.	W.SW	1.2			
	2 p. m.				29.179	47		2 p. m.				29.125	60
	3 p. m.	N.NE	4.8					3 p. m.	E.SE	0.4			
	9 p. m.	North	2.6		29.237	46		9 p. m.	Calm	0.0		29.140	57
13	3 a. m.	North	1.8				25	3 a. m.	N.NE	2.1			
	7 a. m.				29.328	46		7 a. m.				29.189	49
	9 a. m.	N.NE	3.1					9 a. m.	North	5.2	3.30		
	2 p. m.				29.303	50		2 p. m.				29.217	51
	3 p. m.	N.NE	3.8					3 p. m.	N.NE	4.2	3.29		
	9 p. m.	North	2.8		29.323	49		9 p. m.	N.NE	2.2	3.39	29.245	52
14	3 a. m.	North	2.4				26	3 a. m.	N.NE	2.4	3.35		
	7 a. m.				29.411	48		7 a. m.				29.270	53
	9 a. m.	N.NE	4.0					9 a. m.	N.NE	2.8	3.39		
	2 p. m.				29.333	58		2 p. m.				29.252	61
	3 p. m.	North	5.6					3 p. m.	NE	0.8	3.36		
	9 p. m.	North	3.5	3.50	29.310	56		9 p. m.	Calm	0.0	3.45	29.240	53
15	3 a. m.	N.NE	1.3	3.53			27	3 a. m.	NW	0.3	3.45		
	7 a. m.				29.335	54		7 a. m.				29.317	59
	9 a. m.	N.NE	3.7	3.47				9 a. m.	NE	2.3	3.43		
	2 p. m.				29.355	58		2 p. m.				29.392	56
	3 p. m.	N.NE	3.3	3.53				3 p. m.	NE	3.1	3.41		
	9 p. m.	North	0.5	3.44	29.377	52		9 p. m.	North	3.5	3.43	29.487	48
16	3 a. m.	Calm	0.0	3.50			28	3 a. m.	Calm	0.0	3.52		
	7 a. m.				29.392	58		7 a. m.				29.590	50
	9 a. m.	N.NE	3.3	3.47				9 a. m.	E.SE	3.7	3.41		
	2 p. m.				29.342	67		2 p. m.				29.535	61
	3 p. m.	N.NE	3.8	3.53				3 p. m.	E.SE	1.8	3.44		
	9 p. m.	North	2.4	3.41	29.337	58		9 p. m.	S.SE	0.9	3.45	29.437	56
17	3 a. m.	N.NE	1.7	3.46			29	3 a. m.	S.SW	3.1	3.56		
	7 a. m.				29.387	56		7 a. m.				29.207	60
	9 a. m.	N.NE	2.9	3.43				9 a. m.	SW	3.7	3.43		
	2 p. m.				29.354	62		2 p. m.				29.108	79
	3 p. m.	North	3.1	3.46				3 p. m.	NE	2.1	3.41		
	9 p. m.	N.NE	3.1	3.37	29.337	59		9 p. m.	Calm	0.0	3.39	29.181	58
18	3 a. m.	N.NE	0.6	3.46			30	3 a. m.	Calm	0.0	3.44		
	7 a. m.				29.367	53		7 a. m.				29.098	62
	9 a. m.	N.NE	3.1	3.40				9 a. m.	SW	2.3	3.42		
	2 p. m.				29.351	72		2 p. m.				29.997	88
	3 p. m.	N.NE	2.0	3.44				3 p. m.	SW	5.0	3.41		
	9 p. m.	Calm	0.0	3.34	29.324	60		9 p. m.	S.SW	3.0	3.25	29.035	76

TABLE AA.—*Showing the wind, water, barometer, &c.*—Continued.

Date.	Hour of day.	WIND.		Heig't of water above zero of tide gauge.	Barometer reduced to 32°.	Therm'r detached.	Date.	Hour of day.	WIND.		Heig't of water above zero of tide gauge.	Barometer reduced to 32°.	Therm'r detached.
		Course.	Relative velocity.						Course.	Relative velocity.			
1864. May 31	3 a. m.	North ..	2.4	3.35	....	...	1864. June 12	3 a. m.	N. NW .	1.6	3.45	....	...
	7 a. m.	....	...	......	29.241	53		7 a. m.	....	...	......	29.653	52
	9 a. m.	North ..	5.9	3.24	....	...		9 a. m.	NE.....	1.5	3.40	....	...
	2 p. m.	....	...	......	29.291	54		2 p. m.	....	...	......	29.635	55
	3 p. m.	North ..	6.2	3.30	....	...		3 p. m.	N. NE ..	4.6	3.35	....	...
	9 p. m.	North ..	2.2	3.28	29.410	48		9 p. m.	N. NE ..	2.1	3.32	29.610	49
June 1	3 a. m.	N. NE ..	0.5	3.47	....	...	13	3 a. m.	Calm ...	0.0	3.36	....	...
	7 a. m.	....	...	......	29.460	51		7 a. m.	....	...	......	29.689	51
	9 a. m.	N. NE ..	0.6	3.41	....	...		9 a. m.	E. NE ..	1.3	3.40	....	...
	2 p. m.	....	...	......	29.462	61		2 p. m.	....	...	......	29.642	57
	3 p. m.	Calm ...	0.0	3.50	....	...		3 p. m.	N. NE ..	0.6	3.44	....	...
	9 p. m.	Calm ...	0.0	3.44	29.417	54		9 p. m.	Calm ...	0.0	3.41	29.550	48
2	3 a. m.	W. SW .	0.4	3.52	....	...	14	3 a. m.	Calm ...	0.0	3.46	....	...
	7 a. m.	....	...	......	29.427	57		7 a. m.	....	...	......	29.592	54
	9 a. m.	NE.....	1.0	3.48	....	...		9 a. m.	E. SE ..	0.9	3.43	....	...
	2 p. m.	....	...	......	29.444	58		2 p. m.	....	...	......	29.484	63
	3 p. m.	NE.....	0.2	3.51	....	...		3 p. m.	E. SE ..	0.9	3.43	....	...
	9 p. m.	Calm ...	0.0	3.48	29.477	50		9 p. m.	Calm ...	0.0	3.43	20.438	54
3	3 a. m.	Calm ...	0.0	3.52	....	...	15	3 a. m.	Calm ...	0.0	3.47	....	...
	7 a. m.	....	...	......	29.457	58		7 a. m.	....	...	......	29.454	60
	9 a. m.	SW	0.3	3.53	....	...		9 a. m.	E. SE ..	0.6	3.44	....	...
	2 p. m.	....	...	......	29.351	74		2 p. m.	....	...	......	29.421	67
	3 p. m.	SW	0.3	3.50	....	...		3 p. m.	E. SE ..	1.4	3.51	....	...
	9 p. m.	Calm ...	0.0	3.54	29.340	65		9 p. m.	Calm. ..	0.0	3.47	29.401	61
4	3 a. m.	Calm ...	0.0	3.53	....	...	16	3 a. m.	Calm ...	0.0	3.54	....	...
	7 a. m.	....	...	......	29.298	68		7 a. m.	....	...	......	29.454	66
	9 a. m.	S. SW ..	1.1	3.55	....	...		9 a. m.	E. SE ..	0.6	3.50	....	...
	2 p. m.	....	...	......	29.212	71		2 p. m.	....	...	......	29.423	73
	3 p. m.	S. SE...	1.7	3.53	....	...		3 p. m.	E. SE ..	0.6	3.56	....	...
	9 p. m.	S. SE...	0.2	3.52	29.132	66		9 p. m.	Calm ...	0.0	3.47	29.328	66
5	3 a. m.	S. SE. ..	0.4	3.50	....	...	17	3 a. m.	Calm ...	0.0	3.52	....	...
	7 a. m.	....	...	......	29.035	70		7 a. m.	....	...	......	29.456	66
	9 a. m.	SW	2.5	3.53	....	...		9 a. m.	NE.....	0.3	3.47	....	...
	2 p. m.	....	...	......	28.965	81		2 p. m.	....	...	......	29.408	74
	3 p. m.	W. SW .	0.3	3.46	....	...		3 p. m.	E. SE ..	0.3	3.48	....	...
	9 p. m.	W.NW .	2.9	3.44	29.037	75		9 p. m.	Calm ...	0.0	3.42	29.355	62
6	3 a. m.	NW	2.8	3.45	....	...	18	3 a. m.	Calm ...	0.0	......	....	...
	7 a. m.	....	...	......	29.429	53		7 a. m.	....	...	......	29.341	61
	9 a. m.	NE.....	3.4	3.57	....	...		9 a. m.	E. SE ..	0.5	......	....	...
	2 p. m.	....	...	......	29.554	52		2 p. m.	....	...	......	29.363	71
	3 p. m.	N. NE ..	2.1	3.64	....	...		3 p. m.	E SE ..	1.2	3.42	....	...
	9 p. m.	Calm ...	0.0	3.69	29.560	47		9 p. m.	NE.....	0.1	3.41	29.308	67
7	3 a. m.	Calm ...	0.0	3.57	....	...	19	3 a. m.	N. NE ..	0.3	3.39	....	...
	7 a. m.	....	...	......	29.642	51		7 a. m.	....	...	......	29.313	71
	9 a. m.	E. SE ..	0.9	3.56	....	...		9 a. m.	E. NE ..	0.8	3.42	....	...
	2 p. m.	....	...	......	29.592	64		2 p. m.	....	...	......	29.345	79
	3 p. m.	E. SE ..	1.0	3.47	....	...		3 p. m.	E. SE ..	1.0	3.41	....	...
	9 p. m.	Calm ...	0.0	3.43	29.512	50		9 p. m.	Calm ...	0.0	3.42	29.362	67
8	3 a. m.	Calm ...	0.0	3.39	....	...	20	3 a. m.	Calm ...	0.0	3.41	....	...
	7 a. m.	....	...	......	29.369	59		7 a. m.	....	...	......	29.470	....
	9 a. m.	Calm ...	0.0	3.46	....	...		9 a. m.	E. NE ..	0.6	3.47	....	...
	2 p. m.	....	...	......	29.234	71		2 p. m.	....	...	......	29.435	75
	3 p. m.	S. SW..	2.2	3.43	....	...		3 p. m.	E. NE ..	1.4	3.41	....	...
	9 p. m.	S. SW..	1.1	3.55	29.085	70		9 p. m.	NW	0.3	3.44	29.435	66
9	3 a. m.	W. SW .	1.2	3.54	....	...	21	3 a. m.	Calm ...	0.1	3.42	....	...
	7 a. m.	....	...	......	29.030	72		7 a. m.	....	...	......	29.488	70
	9 a. m.	N. NE ..	2.8	3.53	....	...		9 a. m.	East....	0.6	3.47	....	...
	2 p. m.	....	...	......	29.194	57		2 p. m.	....	...	......	29.495	80
	3 p. m.	North ..	3.5	3.53	....	...		3 p. m.	E. SE ..	1.1	3.41	....	...
	9 p. m.	North ..	3.8	3.49	29.247	48		9 p. m.	Calm ...	0.0	3.44	29.500	69
10	3 a. m.	North ..	3.2	3.45	....	...	22	3 a. m.	Calm ...	0.0	3.42	....	...
	7 a. m.	....	...	......	29.403	47		7 a. m.	....	...	......	29.547	75
	9 a. m.	North ..	4.4	3.42	....	...		9 a. m.	E. SE ..	0.8	3.48	....	...
	2 p. m.	....	...	......	29.440	51		2 p. m.	....	...	......	29.497	83
	3 p. m.	North ..	3.2	3.41	....	...		3 p. m.	E. SE ..	1.5	3.43	....	...
	9 p. m.	N. NE ..	1.8	3.42	29.411	45		9 p. m.	Calm ...	0.0	3.51	29.452	76
11	3 a. m.	N. NE ..	2.3	3.41	....	...	23	3 a. m.	Calm ...	0.0	3.50	....	...
	7 a. m.	....	...	......	29.561	46		7 a. m.	....	...	......	29.524	80
	9 a. m.	N. NE ..	3.6	3.44	....	...		9 a. m.	West ...	1.1	3.60	....	...
	2 p. m.	....	...	......	20.563	56		2 p. m.	....	...	......	29.472	85
	3 p. m.	N. NE ..	3.0	3.49	....	...		3 p. m.	E. SE ..	1.7	3.52	....	...
	9 p. m.	N. NW .	0.6	3.48	29.537	50		9 p. m.	Calm ...	0.0	3.57	29.427	76

TABLE AA.—*Showing the wind, water, barometer, &c.*—Continued.

Date.	Hour of day.	WIND.		Heig't of water above zero of tide-gauge.	Barometer reduced to 32°.	Therm'r detached.
		Course.	Relative velocity.			
1864. June 24	3 a. m.	Calm	0.0	3.52	....	....
	7 a. m.	....	....	....	29.499	94
	9 a. m.	S. SW	1.2	3.60	....	....
	2 p. m.	....	....	....	29.399	89
	3 p. m.	S.SW	2.5	3.55	....	....
	9 p. m.	SW	0.6	3.65	29.339	83
25	3 a. m.	SW	0.2	3.64	....	....
	7 a. m.	....	....	....	29.401	82
	9 a. m.	W. SW	4.2	3.74	....	....
	2 p. m.	....	....	....	29.306	94
	3 p. m.	W. SW	4.3	3.74	....	....
	9 p. m.	SW	1.8	3.82	29.329	75
26	3 a. m.	SW	1.8	3.71	....	....
	7 a. m.	....	....	....	29.447	82
	9 a. m.	West	3.3	3.72	....	....
	2 p. m.	....	....	....	29.291	92
	3 p. m.	West	4.8	3.62	....	....
	9 p. m.	N. NE	4.8	3.45	29.430	53
27	3 a. m.	N. NE	4.7	3.56	....	....
	7 a. m.	....	....	....	29.590	50
	9 a. m.	N. NE	4.3	3.44	....	....
	2 p m.	....	....	....	29.617	56
	3 p. m.	N. NE	3.1	3.47	....	....
	9 p. m.	E. NE	0.1	3.44	29.587	51
28	3 a. m.	Calm	0.0	3.49	....	....
	7 a. m.	....	....	....	29.610	56
	9 a. m.	E. SE	1.4	3.48	....	....
	2 p. m.	....	....	....	29.509	61
	3 p. m.	S.SW	0.3	3.50	....	....
	9 p. m.	SE	0.1	3.41	29.416	60
29	3 a. m.	S.SW	0.2	3.44	....	....
	7 a. m.	....	....	....	29.301	76
	9 a. m.	N. NE	1.2	3.42	....	....
	2 p. m.	....	....	....	29.258	83
	3 p. m.	S.SW	2.2	3.49	....	....
	9 p. m.	SW	0.3	3.41	29.222	83
30	3 a. m.	SW	0.2	3.53	....	....
	7 a. m.	....	....	....	29.245	75
	9 a. m.	N.NW	0.5	3.48	....	....
	2 p. m.	....	....	....	29.328	65
	3 p. m.	N. NE	3.4	3.53	....	....
	9 p. m.	SW	0.3	3.48	29.378	59
July 1	3 a. m.	....	....	3.57	....	....
	7 a. m.	....	....	....	29.216	53
	9 a. m.	N. NE	1.6	3.51	....	....
	2 p. m.	....	....	....	29.189	58
	3 p. m.	N. NE	1.8	3.52	....	....
	9 p. m.	Calm	0.0	3.48	29.279	58
2	3 a. m.	Calm	0.0	3.50	....	....
	7 a. m.	....	....	....	29.294	58
	9 a. m.	W.NW	1.1	3.60	....	....
	2 p. m.	....	....	....	29.293	75
	3 p. m.	W.NW	2.2	3.64	....	....
	9 p. m.	Calm	0.0	3.66	29.331	65
3	3 a. m.	Calm	0.0	3.75	....	....
	7 a. m.	....	....	....	29.408	70
	9 a. m.	W.NW	0.2	3.73	....	....
	2 p. m.	....	....	....	29.371	74
	3 p. m.	SE	0.8	3.66	....	....
	9 p. m.	Calm	0.0	3.68	29.381	65
4	3 a. m.	Calm	0.0	3.66	....	....
	7 a. m.	....	....	....	29.433	68
	9 a. m.	S. SW	0.6	3.63	....	....
	2 p. m.	....	....	....	29.405	81
	3 p. m.	S. SW	1.1	3.59	....	....
	9 p. m.	S.SE	0.1	3.59	29.373	68
5	3 a. m.	Calm	0.0	3.59	....	....
	7 a. m.	....	....	....	29.413	72
	9 a. m.	South	1.6	3.61	....	....
	2 p. m.	....	....	....	29.333	75
	3 p. m.	E. SE	0.2	3.60	....	....
	9 p. m.	E. SE	0.7	3.59	29.308	65
1864. July 6	3 a. m.	Calm	0.0	3.52	....	....
	7 a. m.	....	....	....	29.213	66
	9 a. m.	N. NE	0.3	3.57	....	....
	2 p. m.	....	....	....	29.240	68
	3 p. m.	N. NE	2.3	3.51	....	....
	9 p. m.	N. NE	0.6	3.50	29.243	....
7	3 a. m.	NW	0.4	3.47	....	....
	7 a. m.	....	....	....	29.211	68
	9 a. m.	W. NW	1.7	3.57	....	....
	2 p. m.	....	....	....	29.260	82
	3 p. m.	W.NW	2.3	3.49	....	....
	9 p. m.	Calm	0.0	3.53	29.318	73
8	3 a. m.	Calm	0.0	3.54	....	....
	7 a. m.	....	....	....	29.473	69
	9 a. m.	E. NE	0.8	3.65	....	....
	2 p. m.	....	....	....	29.495	79
	3 p. m.	SE	0.6	3.64	....	....
	9 p. m.	Calm	0.0	3.65	29 465	68
9	3 a. m.	Calm	0.0	3.56	....	....
	7 a. m.	....	....	....	29.443	71
	9 a. m.	E. SE	1.0	3.58	....	....
	2 p. m.	....	....	....	29.370	72
	3 p. m.	E. SE	1.7	3.58	....	....
	9 p. m.	SW	0.8	3.52	29.302	75
10	3 a. m.	W. SW	1.8	3.58	....	....
	7 a. m.	....	....	....	29.265	70
	9 a. m.	West	2.4	3.60	....	....
	2 p. m.	....	....	....	29.230	85
	3 p. m.	W. SW	2.3	3.64	....	....
	9 p. m.	S.SW	0.7	3.64	29.207	77
11	3 a. m.	W.NW	1.8	3.68	....	....
	7 a. m.	....	....	....	29.292	70
	9 a. m.	W.NW	3.0	3.70	....	....
	2 p. m.	....	....	....	29.300	81
	3 p. m.	NW	2.3	3.65	....	....
	9 p. m.	N. NE	0.1	3.66	29.340	67
12	3 a. m.	N.NE	0.9	3.65	....	....
	7 a. m.	....	....	....	29.495	65
	9 a. m.	NE	1.7	3.65	....	....
	2 p. m.	....	....	....	29.510	70
	3 p. m.	NE	1.1	3.64	....	....
	9 p. m.	N.NE	0.2	3.56	29.505	63
13	3 a. m.	Calm	0.0	3.56	....	....
	7 a. m.	....	....	....	29.531	63
	9 a. m.	E. NE	0.6	3.55	....	....
	2 p. m.	....	....	....	29.510	72
	3 p. m.	E.SE	1.9	3.55	....	....
	9 p. m.	E.SE	0.1	3.50	29.483	67
14	3 a. m.	Calm	0.0	3.55	....	....
	7 a. m.	....	....	....	29.518	69
	9 a. m.	E.SE	1.9	3.52	....	....
	2 p. m.	....	....	....	29.493	74
	3 p. m.	E.SE	1.7	3.59	....	....
	9 p. m.	Calm	0.0	3.53	29.444	68
15	3 a. m.	Calm	0.0	3.59	....	....
	7 a. m.	....	....	....	29.420	68
	9 a. m.	E.SE	0.9	3.55	....	....
	2 p. m.	....	....	....	29.398	78
	3 p. m.	SE	2.0	3.64	....	....
	9 p. m.	SE	0.1	3.55	29.360	73
16	3 a. m.	Calm	0.0	3.63	....	....
	7 a. m.	....	....	....	29.378	74
	9 a. m.	E.SE	1.3	3.59	....	....
	2 p. m.	....	....	....	29.370	78
	3 p. m.	E.SE	1.3	3.57	....	....
	9 p. m.	SE	1.2	3.55	29.330	73
17	3 a. m.	S. SE	2.5	3.59	....	....
	7 a. m.	....	....	....	29.335	71
	9 a. m.	S. SW	2.1	3.55	....	....
	2 p. m.	....	....	....	29.350	85
	3 p. m.	S.SE	1.8	3.52	....	....
	9 p. m.	SE	1.2	3.46	29.307	70

TABLE AA.—*Showing the wind, water, barometer, &c.*—Continued.

Date.	Hour of day.	WIND.		Heig't of water above zero of tide-gauge.	Barometer reduced to 32°.	Therm'r detached.
		Course.	Relative velocity.			
1864. July 18	3 a. m.	SE	1.6	3.48	....	....
	7 a. m.	....	....	....	29.550	66
	9 a. m.	South	1.8	3.59	....	....
	2 p. m.	....	....	....	29.498	73
	3 p. m.	SW	0.9	3.55	....	....
	9 p. m.	SE	0.5	3.63	29.468	71
19	3 a. m.	....	....	3.61	....	....
	7 a. m.	....	....	....	29.483	70
	9 a. m.	South	2.0	3.74	....	....
	2 p. m.	....	....	....	29.420	74
	3 p. m.	SW	1.6	3.66	....	....
	9 p. m.	W. SW	0.7	3.76	29.415	70
20	3 a. m.	N. NW	1.2	3.62	....	....
	7 a. m.	....	....	....	29.488	68
	9 a. m.	N. NE	2.9	3.79	....	....
	2 p. m.	....	....	....	29.538	69
	3 p. m.	NE	2.6	3.70	....	....
	9 p. m.	N. NE	3.0	3.68	29.581	....
21	3 a. m.	N. NE	3.1	3.54	....	....
	7 a. m.	....	....	....	29.688	57
	9 a. m.	N. NE	3.9	3.62	....	....
	2 p. m.	....	....	....	29.674	67
	3 p. m.	N. NE	3.0	3.58	....	....
	9 p. m.	N.NW	0.5	3.65	29.654	59
22	3 a. m.	Calm	0.0	3.59	....	....
	7 a. m.	....	....	....	29.696	63
	9 a. m.	SW	0.7	3.69	....	....
	2 p. m.	....	....	....	29.638	75
	3 p. m.	E. SE	1.3	3.67	....	....
	9 p. m.	SW	0.5	3.76	29.603	66
23	3 a. m.	W. SW	1.5	3.74	....	....
	7 a. m.	....	....	....	29.621	66
	9 a. m.	W. NW	2.4	3.79	....	....
	2 p. m.	....	....	....	29.578	78
	3 p. m.	W. SW	2.7	3.76	....	....
	9 p. m.	SW	0.6	3.74	29.533	68
24	3 a. m.	W. SW	0.8	3.70	....	....
	7 a. m.	....	....	....	29.540	67
	9 a. m.	W. SW	2.2	3.71	....	....
	2 p. m.	....	....	....	29.460	81
	3 p. m.	W. SW	1.0	3.69	....	....
	9 p. m.	Calm	0.0	3.76	29.428	69
25	3 a. m.	W. SW	0.3	3.66	....	....
	7 a. m.	....	....	....	29.353	69
	9 a. m.	W. SW	1.4	3.65	....	....
	2 p. m.	....	....	....	29.295	82
	3 p. m.	S. SW	0.9	3.61	....	....
	9 p. m.	S. SW	0.3	3.57	29.300	73
26	3 a. m.	N. NE	0.5	3.59	....	....
	7 a. m.	....	....	....	29.380	66
	9 a. m.	N. NE	2.0	3.71	....	....
	2 p. m.	....	....	....	29.440	67
	3 p. m.	E. NE	0.8	3.67	....	....
	9 p. m.	Calm	0.0	3.68	29.470	66
27	3 a. m.	Calm	0.0	3.71	....	....
	7 a. m.	....	....	....	29.515	64
	9 a. m.	E. SE	0.4	3.66	....	....
	2 p. m.	....	....	....	29.558	80
	3 p. m.	SE	1.5	3.69	....	....
	9 p. m.	S. SE	0.3	3.62	29.422	74
28	3 a. m.	SW	0.8	3.70	....	....
	7 a. m.	....	....	....	29.395	74
	9 a. m.	SW	1.8	3.69	....	....
	2 p. m.	....	....	....	29.344	90
	3 p. m.	SW	1.5	3.75	....	....
	9 p. m.	W. SW	0.7	3.69	29.304	79
29	3 a. m.	W. SW	0.3	3.74	....	....
	7 a. m.	....	....	....	29.324	75
	9 a. m.	W. SW	1.8	3.68	....	....
	2 p. m.	....	....	....	29.267	81
	3 p. m.	NE	0.8	3.67	....	....
	9 p. m.	W. SW	0.3	3.60	29.247	74
1864. July 30	3 a. m.	W. SW	0.4	3.68	....	....
	7 a. m.	....	....	....	29.242	78
	9 a. m.	....	....	3.66	....	....
	2 p. m.	....	....	....	29.194	92
	3 p. m.	SW	1.2	3.69	....	....
	9 p. m.	S. SW	0.7	3.68	29.196	80
31	3 a. m.	SW	0.6	3.72	....	....
	7 a. m.	....	....	....	29.217	76
	9 a. m.	E.SE	1.0	3.70	....	....
	2 p. m.	....	....	....	29.184	73
	3 p. m.	S. SW	1.8	3.80	....	....
	9 p. m.	....	....	3.64	29.139	76
Aug. 1	3 a. m.	W.SW	1.4	3.69	....	....
	7 a. m.	....	....	....	29.190	69
	9 a. m.	W. NW	1.5	3.65	....	....
	2 p. m.	....	....	....	29.215	75
	3 p. m.	E.NE	0.9	3.65	....	....
	9 p. m.	N. NE	0.4	3.63	29.282	67
2	3 a. m.	N.NW	0.7	3.64	....	....
	7 a. m.	....	....	....	29.345	65
	9 a. m.	N.NE	2.9	3.60	....	....
	2 p. m.	....	....	....	29.360	70
	3 p. m.	N.NE	2.0	3.55	....	....
	9 p. m.	N.NE	0.7	3.59	29.465	65
3	3 a. m.	NE	0.4	3.56	....	....
	7 a. m.	....	....	....	29.335	66
	9 a. m.	NE	1.0	3.58	....	....
	2 p. m.	....	....	....	29.280	75
	3 p. m.	N. NE	1.0	3.59	....	....
	9 p. m.	N. NE	0.3	3.54	29.248	66
4	3 a. m.	N. NE	0.1	3.53	....	....
	7 a. m.	....	....	....	29.247	66
	9 a. m.	NE	1.4	3.60	....	....
	2 p. m.	....	....	....	29.230	72
	3 p. m.	N. NE	2.4	2.53	....	....
	9 p. m.	N. NW	1.2	3.56	29.278	66
5	3 a. m.	North	1.5	3.49	....	....
	7 a. m.	....	....	....	29.347	68
	9 a. m.	N. NE	3.4	3.53	....	....
	2 p. m.	....	....	....	29.368	73
	3 p. m.	N. NE	2.6	3.48	....	....
	9 p. m.	N. NE	0.8	3.47	29.398	68
6	3 a. m.	N. NE	0.1	3.44	....	....
	7 a. m.	....	....	....	29.475	67
	9 a. m.	N. NE	1.3	3.50	....	....
	2 p. m.	....	....	....	29.483	78
	3 p. m.	N. NE	1.6	3.52	....	....
	9 p. m	N. NW	0.1	3.56	29.508	69
7	3 a. m.	N.NW	0.1	3.52	....	....
	7 a. m.	....	....	....	29.585	71
	9 a. m.	NE	0.7	3.61	....	....
	2 p. m.	....	....	....	29.595	83
	3 p. m	E. SE	0.5	3.62	....	....
	9 p. m.	Calm	0.0	3.63	29.555	71
8	3 a. m.	Calm	0.0	3.63	....	....
	7 a. m.	....	....	....	29.570	69
	9 a. m.	SE	0.6	3.69	....	....
	2 p. m.	....	....	....	29.490	78
	3 p. m.	SE	1.5	3.62	....	....
	9 p. m.	Calm	0.0	3.69	29.414	84
9	3 a. m.	Calm	0.0	3.66	....	....
	7 a. m.	....	....	....	29.385	75
	9 a. m.	SW	1.0	3.69	....	....
	2 p. m.	....	....	....	29.299	59
	3 p. m.	SE	1.3	3.69	....	....
	9 p. m.	S.SW	0.5	3.74	29.242	79
10	3 a. m.	W.SW	0.5	3.73	....	....
	7 a. m.	....	....	....	20.267	78
	9 a. m.	W. SW	1.2	3.75	....	....
	2 p. m.	....	....	....	29.224	82
	3 p. m.	E. SE	1.6	3.74	....	....
	9 p. m.	S. SW	0.3	3.72	29.231	77

TABLE AA.—*Showing the wind, water, barometer, &c.*—Continued.

Date.	Hour of day.	WIND.		Heig't of water above zero of tide-gauge.	Barometer reduced to 32°.	Therm'r detached.
		Course.	Relative velocity.			
1864. Aug. 11	3 a. m.	Calm	0.0	3.73		
	7 a. m.				29.257	79
	9 a. m.	E. SE	1.0	3.71		
	2 p. m.				29.224	85
	3 p. m.	SE	1.9	3.68		
	9 p. m.	E. SE	0.2	3.63	29.241	78
12	3 a. m.	S. SW	0.5	3.68		
	7 a. m.				29.227	77
	9 a. m.	S. SW	1.8	3.71		
	2 p. m.				29.141	88
	3 p. m.	S. SW	2.4	3.75		
	9 p. m.	S. SW	1.4	3.73	29.152	74
13	3 a. m.	SW	1.7	3.85		
	7 a. m.				29.187	75
	9 a. m.	NW	2.2	3.77		
	2 p. m.				29.282	83
	3 p. m.	E. SE	1.1	3.83		
	9 p. m.	Calm	0.0	3.82	29.332	74
14	3 a. m.	NW	0.3	3.83		
	7 a. m.				29.415	73
	9 a. m.	NE	0.7	3.78		
	2 p. m.				29.400	79
	3 p. m.	NE	1.7	3.74		
	9 p. m.	Calm	0.0	3.76	29.382	72
15	3 a. m.	Calm	0.0	3.72		
	7 a. m.				29.345	67
	9 a. m.	E. SE	0.6	3.70		
	2 p. m.				29.320	79
	3 p. m.	E. SE	1.3	3.72		
	9 p. m.	Calm	0.0	3.72	29.327	74
16	3 a. m.	Calm	0.0	3.71		
	7 a. m.				29.360	71
	9 a. m.	North	4.1	3.60		
	2 p. m.				29.443	69
	3 p. m.	N. NE	4.3	3.48		
	9 p. m.	N. NE	3.9	3.46	29.488	66
17	3 a. m.	N. NW	2.3	3.51		
	7 a. m.				29.661	58
	9 a. m.	N. NE	3.8	3.59		
	2 p. m.				29.568	68
	3 p. m.	N. NE	2.7	3.58		
	9 p. m.	NW	0.3	3.64	29.566	58
18	3 a. m.	Calm	0.0	3.69		
	7 a. m.				29.584	60
	9 a. m.	E. NE	0.4	3.77		
	2 p. m.				29.566	74
	3 p. m.	East	1.1	3.75		
	9 p. m.	Calm	0.0	3.79	29.568	60
19	3 a. m.	Calm	0.0	3.74		
	7 a. m.				29.566	57
	9 a. m.	E. NE	0.6	3.78		
	2 p. m.				29.513	76
	3 p. m.	E. SE	0.5	3.68		
	9 p. m.	Calm	0.0	3.69	29.495	61
20	3 a. m.	Calm	0.0	3.63		
	7 a. m.				29.481	58
	9 a. m.	N. NE	1.7	3.68		
	2 p. m.				29.406	74
	3 p. m.	N. NE	1.7	3.61		
	9 p. m.	N. NW	0.1	3.62	29.363	62
21	3 a. m.	NW	0.1	3.58		
	7 a. m.				29.348	58
	9 a. m.	NE	1.2	3.65		
	2 p. m.				29.328	73
	3 p. m.	NE	1.0	3.66		
	9 p. m.	Calm	0.0	3.74	29.368	63
22	3 a. m.	Calm	0.0	3.77		
	7 a. m.				29.406	59
	9 a. m.	E. SE	0.7	3.85		
	2 p. m.				29.353	74
	3 p. m.	SE	1.9	3.80		
	9 p. m.	S. SE	0.4	3.80	29.310	67

Date.	Hour of day.	WIND.		Heig't of water above zero of tide-gauge.	Barometer reduced to 32°.	Therm'r detached.
		Course.	Relative velocity.			
1864. Aug. 23	3 a. m.	S. SE	1.5	3.80		
	7 a. m.				29.258	67
	9 a. m.	S. SE	3.0	3.85		
	2 p. m.				29.143	67
	3 p. m.	S. SE	2.8	3.90		
	9 p. m.	S. SW	0.6	3.86	29.158	67
24	3 a. m.	S. SW	1.2	3.89		
	7 a. m.				29.163	68
	9 a. m.	S. SW	1.5	3.88		
	2 p. m.				29.120	83
	3 p. m.	S. SW	1.4	3.91		
	9 p. m.	South	1.0	3.84	29.072	72
25	3 a. m.	W. SW	2.9	3.95		
	7 a. m.				29.148	69
	9 a. m.	West	4.5	3.98		
	2 p. m.				29.220	80
	3 p. m.	West	3.6	4.04		
	9 p. m.	W. SW	0.2	4.08	29.218	67
26	3 a. m.	W. SW	0.6	4.11		
	7 a. m.				29.117	66
	9 a. m.	W. NW	3.3	4.09		
	2 p. m.				29.025	75
	3 p. m.	West	4.2	4.14		
	9 p. m.	W. SW	1.3	4.03	29.007	65
27	3 a. m.	W. SW	1.8	4.16		
	7 a. m.				29.095	65
	9 a. m.	W. NW	4.0	4.12		
	2 p. m.				29.143	70
	3 p. m.	W. NW	3.6	4.18		
	9 p. m.	W. NW	0.3	4.08	29.198	72
28	3 a. m.	W. NW	0.6	4.14		
	7 a. m.				29.228	59
	9 a. m.	NW	2.1	4.07		
	2 p. m.				29.241	72
	3 p. m.	W. NW	2.2	4.02		
	9 p. m.	NW	0.2	3.95	29.291	64
29	3 a. m.	NW	0.4	4.00		
	7 a. m.				29.393	58
	9 a. m.	N. NE	1.3	3.95		
	2 p. m.				29.403	68
	3 p. m.	E. NE	1.0	3.99		
	9 p. m.	Calm	0.0	3.97	29.436	56
30	3 a. m.	Calm	0.0	3.98		
	7 a. m.				29.519	55
	9 a. m.	East	0.9	3.91		
	2 p. m.				29.498	67
	3 p. m.	E. NE	1.2	3.91		
	9 p. m.	NE	0.1	3.89	29.508	62
31	3 a. m.	Calm	0.0	3.93		
	7 a. m.				29.554	56
	9 a. m.	E. SE	1.2	3.90		
	2 p. m.				29.533	68
	3 p. m.	E. SE	1.0	3.89		
	9 p. m.	E. SE	0.4	3.84	29.511	63
Sept. 1	3 a. m.	Calm	0.0	3.95		
	7 a. m.				29.456	63
	9 a. m.	SE	1.8	3.94		
	2 p. m.				29.324	72
	3 p. m.	SE	2.1	3.91		
	9 p. m.	SE	0.3	3.90	29.281	69
2	3 a. m.	Calm	0.0	3.87		
	7 a. m.				29.278	68
	9 a. m.	E. SE	0.7	3.91		
	2 p. m.				29.240	72
	3 p. m.	NE	1.4	3.89		
	9 p. m.	N. NE	2.4	3.86	29.271	64
3	3 a. m.	N. NE	1.5	3.83		
	7 a. m.				29.141	65
	9 a. m.	NE	2.3	3.82		
	2 p. m.				29.168	68
	3 p. m.	N. NE	3.3	3.78		
	9 p. m.	NE	2.5	3.77	29.186	66

TABLE AA.—*Showing the wind, water, barometer, &c.*—Continued.

Date.	Hour of day.	WIND.		Heig't of water above zero of tide-gauge.	Barometer reduced to 32°.	Therm'r detached.	Date.	Hour of day.	WIND.		Heig't of water above zero of tide-gauge.	Barometer reduced to 32°.	Therm'r detached.
		Course.	Relative velocity.						Course.	Relative velocity.			
1864. Sept. 4	3 a. m.	E. NE	2.5	3.71	...	...	1864. Sept. 16	3 a. m.	W. SW	1.0	4.27	...	...
	7 a. m.	...	...	...	29.223	65		7 a. m.	...	...	...	29.424	57
	9 a. m.	NE	3.5	3.70	...	...		9 a. m.	NW	1.3	4.18	...	...
	2 p. m.	...	...	...	29.256	62		2 p. m.	...	...	...	29.404	66
	3 p. m.	N. NE	5.3	3.64	...	...		3 p. m.	E. SE	0.7	4.08	...	...
	9 p. m.	NE	3.5	3.56	29.251	62		9 p. m.	Calm	0.0	4.07	29.374	61
5	3 a. m.	NE	3.4	3.50	...	...	17	3 a. m.	Calm	0.0	4.06	...	...
	7 a. m.	...	...	...	29.276	61		7 a. m.	...	...	...	29.279	58
	9 a. m.	N. NE	3.2	3.52	...	...		9 a. m.	South	2.2	4.14	...	...
	2 p. m.	...	...	...	29.364	63		2 p. m.	...	...	...	29.096	78
	3 p. m.	N. NE	2.7	3.52	...	...		3 p. m.	S. SW	3.8	4.14	...	...
	9 p. m.	E. NE	2.3	3.57	29.419	63		9 p. m.	...	...	4.20	29.022	61
6	3 a. m.	E. NE	2.2	3.62	...	...	18	3 a. m.	...	...	4.12	...	...
	7 a. m.	...	...	...	29.494	60		7 a. m.	...	...	...	29.083	52
	9 a. m.	E. SE	2.9	3.76	...	...		9 a. m.	W. NW	3.0	4.14	...	...
	2 p. m.	...	...	...	29.491	66		2 p. m.	...	...	...	29.182	54
	3 p. m.	East	1.5	3.76	...	...		3 p. m.	W. NW	1.8	4.15	...	...
	9 p. m.	E. SE	2.1	3.74	29.431	65		9 p. m.	Calm	0.0	4.25	29.312	48
7	3 a. m.	E. SE	2.6	3.72	...	...	19	3 a. m.	Calm	0.0	4.30	...	...
	7 a. m.	...	...	...	29.458	64		7 a. m.	...	...	...	29.390	47
	9 a. m.	SE	2.1	3.87	...	...		9 a. m.	SW	1.2	4.38	...	...
	2 p. m.	...	...	...	29.428	63		2 p. m.	...	...	...	...	...
	3 p. m.	SE	1.0	3.83	...	...		3 p. m.	S. SW	1.3	4.36	...	...
	9 p. m.	Calm	0.0	3.88	29.458	63		9 p. m.	SW	0.1	4.34	29.272	55
8	3 a. m.	W. SW	0.9	3.89	...	...	20	3 a. m.	Calm	0.0	4.18	...	...
	7 a. m.	...	...	...	29.533	63		7 a. m.	...	...	...	20.427	50
	9 a. m.	W. SW	1.5	4.03	...	...		9 a. m.	E. SE	0.3	4.22	...	...
	2 p. m.	...	...	...	29.506	70		2 p. m.	...	...	...	29.425	65
	3 p. m.	S. SW	1.7	4.06	...	...		3 p. m.	SE	0.9	4.19	...	...
	9 p. m.	S. SW	0.4	4.08	29.451	67		9 p. m.	Calm	0.0	4.29	29.399	56
9	3 a. m.	SW	1.6	4.13	...	...	21	3 a. m.	Calm	0.0	4.20	...	...
	7 a. m.	...	...	...	29.376	68		7 a. m.	...	...	...	29.282	59
	9 a. m.	W. SW	2.3	4.10	...	...		9 a. m.	N. NE	0.5	4.13	...	...
	2 p. m.	...	...	...	29.295	81		2 p. m.	...	...	...	29.211	64
	3 p. m.	N. NE	2.7	4.03	...	...		3 p. m.	N. NE	1.9	3.99	...	...
	9 p. m.	S. SW	1.8	3.98	29.243	73		9 p. m.	N. NE	0.3	3.89	29.184	59
10	3 a. m.	S. SW	0.3	4.03	...	...	22	3 a. m.	South	1.1	3.83	...	...
	7 a. m.	...	...	...	29.285	65		7 a. m.	...	...	...	28.993	65
	9 a. m.	N. NE	1.2	3.97	...	...		9 a. m.	South	2.7	3.76	...	...
	2 p. m.	...	...	...	29.298	69		2 p. m.	...	...	...	28.935	77
	3 p. m.	N. NE	1.3	3.98	...	...		3 p. m.	South	1.1	3.79	...	...
	9 p. m.	Calm	0.0	3.94	29.311	62		9 p. m.	S. SE	2.7	3.87	28.940	73
11	3 a. m.	Calm	0.0	3.98	...	...	23	3 a. m.	SW	1.6	4.12	...	...
	7 a. m.	...	...	...	29.386	60		7 a. m.	...	...	...	29.062	62
	9 a. m.	N. NE	3.5	3.87	...	...		9 a. m.	W. NW	1.9	4.12	...	...
	2 p. m.	...	...	...	29.457	63		2 p. m.	...	...	...	29.143	60
	3 p. m.	N. NE	3.6	3.94	...	...		3 p. m.	SW	0.6	4.23	...	...
	9 p. m.	N. NE	2.6	3.78	29.466	59		9 p. m.	W. SW	1.1	4.32	29.128	54
12	3 a. m.	NE	2.0	3.87	...	...	24	3 a. m.	W. SW	1.5	4.37	...	...
	7 a. m.	...	...	...	29.486	61		7 a. m.	...	...	...	29.217	43
	9 a. m.	E. SE	2.7	3.82	...	...		9 a. m.	W. NW	4.2	4.33	...	...
	2 p. m.	...	...	...	29.464	64		2 p. m.	...	...	...	29.347	53
	3 p. m.	E. SE	1.9	3.92	...	...		3 p. m.	W. NW	3.4	4.32	...	...
	9 p. m.	E. SE	1.9	...	29.429	62		9 p. m.	W. SW	0.3	4.24	29.485	44
13	3 a. m.	S. SE	1.0	4.05	...	...	25	3 a. m.	Calm	0.0	4.40	...	...
	7 a. m.	...	...	...	29.374	57		7 a. m.	...	...	...	29.533	43
	9 a. m.	SE	2.1	3.98	...	...		9 a. m.	SE	0.5	4.42	...	...
	2 p. m.	...	...	...	29.224	62		2 p. m.	...	...	...	29.345	64
	3 p. m.	SE	3.5	4.07	...	...		3 p. m.	South	1.3	4.21	...	...
	9 p. m.	SE	1.5	4.01	29.154	64		9 p. m.	S. SE	0.2	4.15	29.322	64
14	3 a. m.	West	2.7	4.13	...	...	26	3 a. m.	S. SE	0.6	4.20	...	...
	7 a. m.	...	...	...	29.143	63		7 a. m.	...	...	...	29.240	56
	9 a. m.	W. NW	3.9	4.11	...	...		9 a. m.	S. SW	3.5	4.11	...	...
	2 p. m.	...	...	...	29.188	71		2 p. m.	...	...	...	29.098	78
	3 p. m.	W. SW	3.2	4.21	...	...		3 p. m.	South	3.6	4.11	...	...
	9 p. m.	W. SW	1.7	4.21	29.201	57		9 p. m.	S. SW	3.4	4.07	29.090	69
15	3 a. m.	West	2.1	4.32	...	...	27	3 a. m.	S. SW	2.7	4.22	...	...
	7 a. m.	...	...	...	29.342	54		7 a. m.	...	...	...	28.988	63
	9 a. m.	W.NW	3.1	4.37	...	...		9 a. m.	SW	2.9	4.26	...	...
	2 p. m.	...	...	...	29.376	67		2 p. m.	...	...	...	29.151	60
	3 p. m.	W. NW	2.4	4.39	...	...		3 p. m.	NW	1.6	4.23	...	...
	9 p. m.	W. SW	0.3	4.34	29.406	58		9 p. m.	Calm	0.0	4.31	29.379	50

TABLE AA.—*Showing the wind, water, barometer, &c.*—Continued.

Date.	Hour of day.	Wind.		Heig't of water above zero of tide-gauge.	Barometer reduced to 32°.	Therm'r detached.
		Course.	Relative velocity.			
1864. Sept. 28	3 a. m.	N. NW	1.2	4.33		
	7 a. m.				29.582	43
	9 a. m.	N. NE	1.0	4.38		
	2 p. m.				29.557	54
	3 p. m.	E. SE	0.7	4.28		
	9 p. m.	N. NE	1.6	4.12	29.495	51
29	3 a. m.	N. NE	2.8	3.99		
	7 a. m.				29.320	49
	9 a. m.	NE	2.3	4.02		
	2 p. m.					
	3 p. m.	N. NE	1.8	3.99		
	9 p. m.	Calm	0.0	4.10	29.475	50
30	3 a. m.	Calm	0.0	4.17		
	7 a. m.				29.557	47
	9 a. m.	NE	1.0	4.18		
	2 p. m.				29.550	50
	3 p. m.	E. SE	0.9	4.22		
	9 p. m.	East	0.8	4.09	29.507	50
Oct. 1	3 a. m.	E. SE	0.8	4.11		
	7 a. m.				29.432	50
	9 a. m.	E. SE	1.3	4.11		
	2 p. m.				29.380	56
	3 p. m.	NE	0.6	4.06		
	9 p. m.	Calm	0.0	4.06	29.375	49
2	3 a. m.	Calm	0.0	4.11		
	7 a. m.				29.447	42
	9 a. m.	Calm	0.0	4.24		
	2 p. m.				29.452	56
	3 p. m.	SE	1.2	4.23		
	9 p. m.	Calm	0.0	4.19	29.487	54
3	3 a. m.	Calm	0.0	4.21		
	7 a. m.				29.492	51
	9 a. m.	N. NE	0.5	4.25		
	2 p. m.				25.527	55
	3 p. m.	N. NE	0.7	4.18		
	9 p. m.	Calm	0.0	4.18	29.560	51
4	3 a. m.	N. NE	0.3	4.17		
	7 a. m.				29.592	53
	9 a. m.	NE	2.2	4.21		
	2 p. m.				29.537	57
	3 p. m.	N. NE	2.8	4.14		
	9 p. m.	NE	1.4	4.17	29.422	56
5	3 a. m.	SW	0.8	4.20		
	7 a. m.				29.334	51
	9 a. m.	W. SW	1.0	4.24		
	2 p. m.				29.294	55
	3 p. m.	SE	1.2	4.12		
	9 p. m.	Calm	0.0	4.18	29.179	51
6	3 a. m.	South	0.6	4.17		
	7 a. m.				28.979	49
	9 a. m.	S. SW	1.8	4.34		
	2 p. m.				28.933	54
	3 p. m.	W. SW	2.9	4.29		
	9 p. m.	SW	4.0	4.34	29.078	50
7	3 a. m.	SW	0.5	4.42		
	7 a. m.				29.021	51
	9 a. m.	W. NW	3.3	4.53		
	2 p. m.				22.141	47
	3 p. m.	W. NW	4.5	4.37		
	9 p. m.	NW	2.7	4.25	29.305	38
8	3 a. m.	N. NW	1.8	4.19		
	7 a. m.				29.487	35
	9 a. m.	N. NW	2.4	4.10		
	2 p. m.				29.479	44
	3 p. m.	NW	1.7	4.30		
	9 p. m.	Calm	0.0	4.23	29.494	34
9	3 a. m.	Calm	0.0	4.34		
	7 a. m.				29.429	32
	9 a. m.	S. SW	1.5	4.42		
	2 p. m.				29.189	51
	3 p. m.	S. SW	3.4	4.68		
	9 p. m.	SW	2.5	4.62	29.019	49
1864. Oct. 10	3 a. m.	W. SW	1.4	4.60		
	7 a. m.				29.121	43
	9 a. m.	N. NW	1.2	4.54		
	2 p. m.				29.270	56
	3 p. m.	NW	0.6	4.54		
	9 p. m.	Calm	0.0	4.40	29.450	42
11	3 a. m.	Calm	0.0	4.45		
	7 a. m.				25.535	36
	9 a. m.	South	0.7	4.36		
	2 p. m.				29.470	53
	3 p. m.	SE	0.8	4.38		
	9 p. m.	S. SW	0.1	4.33	29.390	49
12	3 a. m.	W. NW	1.1	4.38		
	7 a. m.				29.393	42
	9 a. m.	N. NW	1.9	4.29		
	2 p. m.				29.445	49
	3 p. m.	N. NE	1.4	4.33		
	9 p. m.	Calm	0.0	5.38	29.503	39
13	3 a. m.	Calm	0.0	4.51		
	7 a. m.				29.488	36
	9 a. m.	W. SW	1.5	4.52		
	2 p. m.				29.329	57
	3 p. m.	SW	1.0	4.59		
	9 p. m.	Calm	0.0	4.44	29.255	43
14	3 a. m.	SW	0.3	4.36		
	7 a. m.				29.149	43
	9 a. m.	SW	0.4	4.18		
	2 p. m.				29.044	57
	3 p. m.	E. SE	0.5	4.08		
	9 p. m.	Calm	0.0	4.00	29.061	49
15	3 a. m.	Calm	0.0	4.07		
	7 a. m.				29.079	44
	9 a. m.	NW	2.0	4.17		
	2 p. m.				29.144	51
	3 p. m.	W. NW	2.4	4.15		
	9 p. m.	W. NW	0.4	4.28	29.265	42
16	3 a. m.	W. SW	0.2	4.38		
	7 a. m.				29.308	34
	9 a. m.	W. SW	0.4	4.49		
	2 p. m.				29.293	51
	3 p. m.	W. NW	1.2	4.50		
	9 p. m.	Calm	0.0	4.53	29.361	39
17	3 a. m.	Calm	0.0	4.59		
	7 a. m.				29.423	30
	9 a. m.	Calm	0.0	4.60		
	2 p. m.				29.330	44
	3 p. m.	N. NE	1.2	4.52		
	9 p. m.	W. NW	0.8	4.52	29.373	39
18	3 a. m.	W. NW	0.9	4.48		
	7 a. m.				29.374	31
	9 a. m.	West	1.8	4.52		
	2 p. m.				29.296	46
	3 p. m.	West	2.1	4.50		
	9 p. m.	W. SW	0.2	4.55	29.273	43
19	3 a. m.	W. NW	0.6	4.51		
	7 a. m.				29.221	39
	9 a. m.	W. NW	0.4	4.48		
	2 p. m.				29.218	50
	3 p. m.	E. SE	0.4	4.37		
	9 p. m.	Calm	0.0		29.315	40
20	3 a. m.	Calm	0.0			
	7 a. m.				29.373	33
	9 a. m.	N. NE	1.0			
	2 p. m.				29.421	47
	3 p. m.	NE	1.0			
	9 p. m.	N. NE	0.7		29.431	45
21	3 a. m.	NE	0.8			
	7 a. m.				29.381	44
	9 a. m.	E. NE	0.6			
	2 p. m.				29.353	45
	3 p. m.	NE	0.4	4.34		
	9 p. m.	West	0.6	4.39	29.413	42

TABLE AA.—*Showing the wind, water, barometer, &c.*—Continued.

Date.	Hour of day.	WIND.		Heig't of water above zero of tide-gauge.	Barometer reduced to 32°.	Therm'r detached.
		Course.	Relative velocity.			
1864.						
Oct. 22	3 a. m.	West	1.3	4.50	....	....
	7 a. m.	....	....	......	29.381	39
	9 a. m.	....	....	4.55	....	....
	2 p. m.	....	....	......	29.328	50
	3 p. m.	W. SW	1.7	4.65	....	....
	9 p. m.	W. SW	1.5	4.65	29.248	46
23	3 a. m.	SW	0.6	4.62	....	....
	7 a. m.	....	....	......	29.091	41
	9 a. m.	West	0.6	4.47	....	....
	2 p. m.	....	....	......	29.006	53
	3 p. m.	N. NE	0.8	4.35	....	....
	9 p. m.	N. NE	3.4	4.17	29.132	47
24	3 a. m.	NW	1.6	4.30	....	....
	7 a. m.	....	....	......	29.318	35
	9 a. m.	NE	0.6	4.26	....	....
	2 p. m.	....	....	......	29.326	47
	3 p. m.	East	0.1	4.35	....	....
	9 p. m.	Calm	0.0	4.39	29.361	39
25	3 a. m.	Calm	0.0	4.48	....	....
	7 a. m.	....	....	......	29.383	33
	9 a. m.	S. SW	0.5	4.46	....	....
	2 p. m.	....	....	......	29.355	51
	3 p. m.	N. NE	1.3	4.56	....	....
	9 p. m.	E. SE	0.7	......	29.345	50
26	3 a. m.	E. SE	1.1	......	....	....
	7 a. m.	....	....	......	29.203	50
	9 a. m.	E. SE	1.5	......	....	....
	2 p. m.	....	....	......	29.101	51
	3 p. m.	E. SE	1.1	4.58	....	....
	9 p. m.	SE	1.7	4.43	28.956	51
27	3 a. m.	S. SW	1.4	4.51	....	....
	7 a. m.	....	....	......	28.836	49
	9 a. m.	S. SW	2.2	4.54	....	....
	2 p. m.	....	....	......	28.841	47
	3 p. m.	SW	2.0	4.58	....	....
	9 p. m.	S. SW	1.2	4.59	28.849	44
28	3 a. m.	SW	1.2	4.68	....	....
	7 a. m.	....	....	......	28.874	44
	9 a. m.	W. SW	2.0	4.76	....	....
	2 p. m.	....	....	......	28.971	46
	3 p. m.	W. SW	1.5	4.85	....	....
	9 p. m.	W. SW	0.3	4.82	29.076	44
29	3 a. m.	W. NW	0.3	4.85	....	....
	7 a. m.	....	....	......	29.205	44
	9 a. m.	W. NW	0.1	4.82	....	....
	2 p. m.	....	....	......	29.245	47
	3 p. m.	West	0.3	4.81	....	....
	9 p. m.	Calm	0.0	4.72	29.343	45
30	3 a. m.	Calm	0.0	4.75	....	....
	7 a. m.	....	....	......	29.428	42
	9 a. m.	Calm	0.0	4.80	....	....
	2 p. m.	....	....	......	29.465	47
	3 p. m.	W. SW	0.3	4.85	....	....
	9 p. m.	Calm	0.0	4.86	29.518	44
31	3 a. m.	Calm	0.0	4.89	....	....
	7 a. m.	....	....	......	29.595	41
	9 a. m.	Calm	0.0	4.89	....	....
	2 p. m.	....	....	......	29.628	45
	3 p. m.	N. NE	0.7	4.83	....	....
	9 p. m.	Calm	0.0	4.84	29.696	41
Nov. 1	3 a. m.	Calm	0.0	4.66	....	....
	7 a. m.	....	....	......	29.757	37
	9 a. m.	Calm	0.0	4.72	....	....
	2 p. m.	....	....	......	29.731	44
	3 p. m.	NE	0.1	4.69	....	....
	9 p. m.	Calm	0.0	4.67	29.711	41
2	3 a. m.	NW	0.1	4.61	....	....
	7 a. m.	....	....	......	29.666	36
	9 a. m.	NE	0.6	4.65	....	....
	2 p. m.	....	....	......	29.561	46
	3 p. m.	NE	0.2	4.62	....	....
	9 p. m.	NW	0.2	4.71	29.533	36
1864.						
Nov. 3	3 a. m.	Calm	0.0	4.62	....	....
	7 a. m.	....	....	......	29.368	34
	9 a. m.	North	0.4	4.71	....	....
	2 p. m.	....	....	......	29.174	43
	3 p. m.	NE	1.2	4.65	....	....
	9 p. m.	NW	1.3	4.67	29.017	43
4	3 a. m.	N. NW	0.6	4.56	....	....
	7 a. m.	....	....	......	28.915	47
	9 a. m.	N. NW	3.7	4.42	....	....
	2 p. m.	....	....	......	28.961	38
	3 p. m.	NW	2.1	4.71	....	....
	9 p. m.	Calm	0.0	4.67	29.105	31
5	3 a. m.	Calm	0.0	4.79	....	....
	7 a. m.	....	....	......	29.207	26
	9 a. m.	S. SE	1.1	4.87	....	....
	2 p. m.	....	....	......	29.160	43
	3 p. m.	S. SE	1.5	4.91	....	....
	9 p. m.	S. SE	2.2	4.95	29.096	41
6	3 a. m.	S. SE	0.9	4.91	....	....
	7 a. m.	....	....	......	28.905	48
	9 a. m.	S. SE	2.5	4.79	....	....
	2 p. m.	....	....	......	28.767	47
	3 p. m.	SW	4.0	4.78	....	....
	9 p. m.	S. SW	1.6	4.83	29.191	42
7	3 a. m.	S. SW	0.2	4.93	....	....
	7 a. m.	....	....	......	29.233	36
	9 a. m.	S. SW	1.1	4.97	....	....
	2 p. m.	....	....	......	29.315	55
	3 p. m.	S. SW	0.8	5.05	....	....
	9 p. m.	SW	0.3	5.00	29.456	48
8	3 a. m.	N. NE	2.5	4.85	....	....
	7 a. m.	....	....	......	29.343	44
	9 a. m.	NE	2.5	4.74	....	....
	2 p. m.	....	....	......	29.184	45
	3 p. m.	N. NE	4.1	4.61	....	....
	9 p. m.	N. NW	2.9	4.50	29.102	44
9	3 a. m.	North	3.9	4.39	....	....
	7 a. m.	....	....	......	28.927	43
	9 a. m.	N. NE	5.3	4.25	....	....
	2 p. m.	....	....	......	28.344	47
	3 p. m.	S. SW	5.6	4.66	....	....
	9 p. m.	W. SW	5.8	5.03	28.607	35
10	3 a. m.	W. SW	4.6	4.89	....	....
	7 a. m.	....	....	......	29.000	29
	9 a. m.	W. SW	3.7	4.85	....	....
	2 p. m.	....	....	......	29.072	32
	3 p. m.	W. SW	3.1	5.18	....	....
	9 p. m.	West	2.4	5.17	29.155	29
11	3 a. m.	W. SW	0.4	5.11	....	....
	7 a. m.	....	....	......	29.107	27
	9 a. m.	West	1.0	5.04	....	....
	2 p. m.	....	....	......	29.077	31
	3 p. m.	N. NW	1.1	4.99	....	....
	9 p. m.	NW	1.3	4.87	29.147	27
12	3 a. m.	NW	1.0	......	....	....
	7 a. m.	....	....	......	29.305	24
	9 a. m.	NW	2.4	......	....	....
	2 p. m.	....	....	......	29.361	31
	3 p. m.	NW	2.2	......	....	....
	9 p. m.	NW	0.9	......	29.480	28
13	3 a. m.	W. NW	0.8	......	....	....
	7 a. m.	....	....	......	29.540	22
	9 a. m.	NW	0.4	......	....	....
	2 p. m.	....	....	......	29.552	32
	3 p. m.	Calm	0.0	......	....	....
	9 p. m.	Calm	0.0	......	29.580	26
14	3 a. m.	Calm	0.0	......	....	....
	7 a. m.	....	....	......	29.567	29
	9 a. m.	SE	1.8	......	....	....
	2 p. m.	....	....	......	29.414	33
	3 p. m.	E. SE	2.8	......	....	....
	9 p. m.	E. SE	0.3	......	29.359	34

TABLE AA.—*Showing the wind, water, barometer, &c.*—Continued.

Date.	Hour of day.	Wind.		Heig't of water above zero of tide-gauge.	Barometer reduced to 32°.	Therm'r detached.
		Course.	Relative velocity.			
1864. Nov. 15	3 a. m.	NW	0.9			
	7 a. m.				29.457	26
	9 a. m.	W.NW.	0.6			
	2 p. m.				29.546	37
	3 p. m.	W.SW.	0.4			
	9 p. m.	Calm	0.0		29.591	30
16	3 a. m.	S.SW	0.4			
	7 a. m.				29.582	32
	9 a. m.	S.SW	1.1			
	2 p. m.				29.520	39
	3 p. m.	SW	0.3	4.48		
	9 p. m.	Calm	0.0	4.43	29.469	36
17	3 a. m.	W.NW.	0.1	4.38		
	7 a. m.				29.474	33
	9 a. m.	W.NW.	1.2	4.49		
	2 p. m.				29.516	34
	3 p. m.	W.NW.	1.8	4.45		
	9 p. m.	W.NW.	1.0	4.69	29.639	31
18	3 a. m.	SW	0.5	4.76		
	7 a. m.				29.634	25
	9 a. m.	W.SW.	1.7	4.88		
	2 p. m.				29.606	37
	3 p. m.	W.SW.	1.7	4.85		
	9 p. m.	West	0.2	4.90	29.607	32
19	3 a. m.	Calm	0.0	4.83		
	7 a. m.				29.502	26
	9 a. m.	S.SW	0.5	4.80		
	2 p. m.				29.299	41
	3 p. m.	S.SW	0.6	4.70		
	9 p. m.	S.SW	0.7	4.70	29.200	36
20	3 a. m.	S.SW	0.2	4.69		
	7 a. m.				29.052	33
	9 a. m.	Calm	0.0	4.54		
	2 p. m.				29.957	37
	3 p. m.	W.SW.	1.9	4.56		
	9 p. m.	W.SW.	4.0	4.66	29.027	26
21	3 a. m.	W.NW.	3.7	4.47		
	7 a. m.				29.220	17
	9 a. m.	W.NW.	4.0	4.55		
	2 p. m.				29.253	23
	3 p. m.	W.NW.	3.5	4.61		
	9 p. m.	W.NW.	3.5	4.61	29.285	15
22	3 a. m.	W.NW.	3.6	4.58		
	7 a. m.				29.276	12
	9 a. m.	W.NW.	4.2	4.53		
	2 p. m.				29.341	16
	3 p. m.	West	3.8	4.47		
	9 p. m.	W.NW.	2.0	4.44	29.441	9
23	3 a. m.	W.SW.	0.2	4.57		
	7 a. m.					7
	9 a. m.	South	0.4	4.58		
	2 p. m.				29.448	29
	3 p. m.	S.SE	0.4			
	9 p. m.	S.SE	0.1		29.483	29
24	3 a. m.	Calm	0.0			
	7 a. m.				29.600	29
	9 a. m.	W.SW.	0.1			
	2 p. m.				29.642	36
	3 p. m.	Calm	0.0			
	9 p. m.	Calm	0.0		29.697	29
25	3 a. m.	Calm	0.0			
	7 a. m.				29.610	32
	9 a. m.	SE	0.4			
	2 p. m.				29.394	40
	3 p. m.	SE	1.5			
	9 p. m.	W.SW.	1.0		29.279	42
26	3 a. m.	SW	0.2			
	7 a. m.				29.226	37
	9 a. m.	W.SW.	1.1			
	2 p. m.				29.289	39
	3 p. m.	W.SW.	0.3			
	9 p. m.	Calm	0.0		29.316	38
1864. Nov. 27	3 a. m.	Calm	0.0			
	7 a. m.				29.221	38
	9 a. m.	SW	0.9			
	2 p. m.				29.097	42
	3 p. m.	SW	1.5			
	9 p. m.	SW	0.5		29.044	45
28	3 a. m.	Calm	0.0			
	7 a. m.				28.947	47
	9 a. m.	Calm	0.0			
	2 p. m.				28.896	50
	3 p. m.	Calm	0.0			
	9 p. m.	Calm	0.0		28.871	47
29	3 a. m.	Calm	0.0			
	7 a. m.				28.804	51
	9 a. m.	SW	1.3			
	2 p. m.				28.876	59
	3 p. m.	SW	1.8			
	9 p. m.	W.SW	5.4		29.056	47
30	3 a. m.	W.SW	1.8			
	7 a. m.				29.445	36
	9 a. m.	W.SW	0.3			
	2 p. m.				29.479	53
	3 p. m.	W.SW	0.7			
	9 p. m.	Calm	0.0		29.528	41
Dec. 1	3 a. m.	Calm	0.0			
	7 a. m.				29.545	43
	9 a. m.	E.SE	0.1			
	2 p. m.				29.393	45
	3 p. m.	E.SE	0.2			
	9 p. m.	E.SE	1.0		29.333	44
2	3 a. m.	E.SE	1.1			
	7 a. m.				29.104	42
	9 a. m.	SE	0.1			
	2 p. m.				28.956	45
	3 p. m.	Calm	0.0			
	9 p. m.	West	0.3		28.966	47
3	3 a. m.	West	1.4			
	7 a. m.				29.102	35
	9 a. m.	West	2.0			
	2 p. m.				29.179	32
	3 p. m.	West	2.5			
	9 p. m.	W.NW.	1.5		29.287	28
4	3 a. m.	W.NW.	0.6			
	7 a. m.				29.342	21
	9 a. m.	Calm	0.0			
	2 p. m.				29.270	31
	3 p. m.	Calm	0.0			
	9 p. m.	E.SE	0.8		29.130	32
5	3 a. m.	E.SE	0.2			
	7 a. m.				28.970	32
	9 a. m.	Calm	0.0			
	2 p. m.				29.067	36
	3 p. m.	W.NW.	0.3			
	9 p. m.	Calm	0.0		29.100	38
6	3 a. m.	Calm	0.0			
	7 a. m.				29.107	26
	9 a. m.	West	0.8			
	2 p. m.				29.137	25
	3 p. m.	Calm	0.0			
	9 p. m.	Calm	0.0		29.147	23
7	3 a. m.	NW	0.1			
	7 a. m.				29.078	13
	9 a. m.	W.NW	1.8			
	2 p. m.				29.123	14
	3 p. m.	West	2.9			
	9 p. m.	W.SW	3.7		29.301	3
8	3 a. m.	West	3.2			
	7 a. m.				29.664	12
	9 a. m.	West	2.5			
	2 p. m.				29.836	8
	3 p. m.	W.SW.	0.9			
	9 p. m.	Calm	0.0		29.918	11

TABLE AA.—*Showing the wind, water, barometer, &c.*—Continued.

Date.	Hour of day.	WIND.		Heig't of water above zero of tide-gauge.	Barometer reduced to 32°.	Therm'r detached.
		Course.	Relative velocity.			
1864. Dec. 9	3 a. m.	Calm	0.0			
	7 a. m.				29.970	12
	9 a. m.	Calm	0.0			
	2 p. m.				29.779	6
	3 p. m.	E.SE	0.3			
	9 p. m.	E.SE	0.4		29.528	22
10	3 a. m.	Calm	0.0			
	7 a. m.				29.407	19
	9 a. m.	Calm	0.0			
	2 p. m.				29.951	23
	3 p. m.	Calm	0.0			
	9 p. m.	SW	0.2		29.276	20
11	3 a. m.	W. SW	0.1			
	7 a. m.				29.073	4
	9 a. m.	South	1.1			
	2 p. m.				29.149	19
	3 p. m.	NW	3.5			
	9 p. m.	West	1.1		29.479	5
12	3 a. m.	W.NW	0.5			
	7 a. m.				29.625	7
	9 a. m.	W.NW	0.1			
	2 p. m.				29.635	8
	3 p. m.	Calm	0.0			
	9 p. m.	Calm	0.0		29.504	8
13	3 a. m.	S. SE	0.6			
	7 a. m.				29.214	5
	9 a. m.	S. SE	0.4			
	2 p. m.				29.041	24
	3 p. m.	Calm	0.0			
	9 p. m.	W.NW	0.7			23
14	3 a. m.	W.NW	0.3			
	7 a. m.				29.393	2
	9 a. m.	Calm	0.0			
	2 p. m.				29.549	9
	3 p. m.	Calm	0.0			
	9 p. m.	Calm	0.0		29.603	2
15	3 a. m.	Calm	0.0			
	7 a. m.				28.401	17
	9 a. m.	Calm	0.0			
	2 p. m.				29.240	28
	3 p. m.	W. SW	0.3			
	9 p. m.	Calm	0.0		29.380	13
16	3 a. m.	Calm	0.0			
	7 a. m.				29.400	12
	9 a. m.	Calm	0.0			
	2 p. m.				29.273	33
	3 p. m.	Calm	0.0			
	9 p. m.	SW	1.1		29.290	31
17	3 a. m.	W. SW	1.2			
	7 a. m.				29.472	30
	9 a. m.	W. SW	1.6			
	2 p. m.				29.630	33
	3 p. m.	NW	0.2			
	9 p. m.	E. NE	1.1		29.734	34
18	3 a. m.	E. SE	1.5			
	7 a. m.				29.569	33
	9 a. m.	SE	1.8			
	2 p. m.				29.396	36
	3 p. m.	S.SW	0.6			
	9 p. m.	W. SW	1.6		29.247	34
19	3 a. m.	W.NW	4.1			
	7 a. m.				29.312	15
	9 a. m.	West	3.4			
	2 p. m.				29.462	15
	3 p. m.	West	3.6			
	9 p. m.	W.SW	1.9		29.480	10
20	3 a. m.	SW	1.2			
	7 a. m.				29.401	4
	9 a. m.	SW	1.6			
1864. Dec. 20	2 p. m.				29.233	23
	3 p. m.	SW	3.0			
	9 p. m.	SW	1.3		29.100	25
21	3 a. m.	N. NW	1.6			
	7 a. m.				28.983	22
	9 a. m.	N. NW	5.4			
	2 p. m.				29.104	17
	3 p. m.	N. NW	4.0			
	9 p. m.	NW	4.0		29.305	10
22	3 a. m.	NW	3.4			
	7 a. m.				29.610	2
	9 a. m.	W. NW	2.1			
	2 p. m.				29.673	5
	3 p. m.	W. SW	1.9			
	9 p. m.	W. SW	0.1		29.720	2
23	3 a. m.	S. SW	0.1			
	7 a. m.				29.507	2
	9 a. m.	S. SW	1.7			
	2 p. m.				29.172	18
	3 p. m.	SW	3.2			
	9 p. m.	W. SW	1.5			
24	3 a. m.	W. NW	2.2			
	7 a. m.				29.356	30
	9 a. m.	S.SW	1.5			
	2 p. m.				29.330	32
	3 p. m.	S. SE	1.9			
	9 p. m.	South	2.8		29.220	33
25	3 a. m.	S. SE	2.5			
	7 a. m.				29.147	35
	9 a. m.	S.SW	2.2			
	2 p. m.				29.065	36
	3 p. m.	W. SW	1.3			
	9 p. m.	SW	0.8		29.097	30
26	3 a. m.	South	1.3			
	7 a. m.				29.060	32
	9 a. m.	S. SE	2.8			
	2 p. m.				28.897	36
	3 p. m.	S. SE	3.0			
	9 p. m.	S. SE	1.7		28.772	37
27	3 a. m.	S. SE	1.6			
	7 a. m.				28.532	35
	9 a. m.	W.SW	3.7			
	2 p. m.				28.647	32
	3 p. m.	W. SW	3.5			
	9 p. m.	W.SW	3.0		28.839	13
28	3 a. m.	W. SW	2.3			
	7 a. m.				29.050	14
	9 a. m.	W. NW	2.3			
	2 p. m.				29.128	20
	3 p. m.	NW	2.5			
	9 p. m.	W. NW	1.6		29.251	14
29	3 a. m.	W. NW	0.2			
	7 a. m.				29.166	1
	9 a. m.	S. SW	0.3			
	2 p. m.				28.968	14
	3 p. m.	S. SE	1.5			
	9 p. m.	SW	1.5		28.841	21
30	3 a. m.	W. SW	2.1			
	7 a. m.				28.901	20
	9 a. m.	W.NW	3.8			
	2 p. m.				29.141	17
	3 p. m.	W. NW	3.1			
	9 p. m.	W. NW	1.7		29.316	9
31	3 a. m.	W. NW	1.1			
	7 a. m.				29.531	7
	9 a. m.	W. NW	1.3			
	2 p. m.				29.581	15
	3 p. m.	W. NW	1.8			
	9 p. m.	W. NW	0.7		29.646	7

TABLE B B.—*Showing the duration of the wind at the several points of the compass for each hour, the stormy and cloudy days being eliminated, for the following months, at Milwaukee, Wisconsin.*

Points.	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
JUNE, 1861.																								
North	2	1	1	....	....	2	1	1	1	....	....	....	....	....	..	..	1	1	..	1	1	..	..	..
N. NE	2	2	2	2	3	3	3	4	4	3	2	1	1	1	1	1	2	3	3	2	..	2	2	2
NE	....	....	....	....	....	....	1	3	2	3	3	4	3	3	1	1	1	1	..	..	..	..	..	..
E. NE	....	....	....	....	....	....	....	1	....	1	....	1	1	....	1	..	..	..	..	..	..	..	..	..
East	....	....	....	....	....	1	1	1	2	1	1	1	....	....	1	1	1	1	2	..	..	..	..	..
E. SE	....	....	....	....	....	....	....	....	2	3	3	3	5	4	3	2	1	1	..	1	..	..	..	..
SE	....	....	....	....	....	....	....	1	4	3	4	4	3	7	5	7	6	6	3	1	1	1	1	1
S. SE	....	....	....	....	....	....	....	....	....	....	1	....	1	....	..	..	..	..	1	..	..	..	..	..
South	....	....	....	....	....	....	....	....	....	....	....	....	1	....	..	..	..	..	..	1	2	1	..	..
S. SW	....	1	....	....	....	....	....	....	....	....	1	1	....	....	1	1	1	1	1	..	1	..	1	1
SW	1	....	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	2	2	1	1	2	2
W. SW	2	3	2	1	....	....	....	....	....	....	....	....	....	....	1	1	2	1	..	..	..	..	1	3
West	2	....	....	....	1	1	1	....	....	....	....	....	....	....	..	..	..	..	..	..	..	..	..	..
W. NW	....	1	2	2	1	....	....	....	....	....	....	....	....	....	3	..	..	..	..	..	..	..	..	..
NW	1	1	....	2	3	4	2	1	....	....	....	....	....	....	..	..	..	..	..	..	..	..	..	..
N. NW	....	1	....	1	1	....	2	1	....	....	....	....	....	....	..	..	..	..	..	..	..	..	1	..
Sums	10	10	8	9	10	12	12	14	16	16	16	16	16	16	16	16	16	16	13	3	7	7	9	10
Calms	6	6	8	7	6	4	3	2	0	0	0	0	0	0	0	0	0	0	3	8	9	9	7	6
JULY, 1861.																								
North	....	....	....	1	....	....	2	2	....	....	1	....	....	....	..	..	..	..	..	..	..	1	1	..
N. NE	....	....	....	....	1	1	1	2	2	1	1	....	....	....	..	..	..	..	1	..	2	2	1	1
NE	....	....	....	....	....	....	....	....	2	2	2	2	1	1	..	..	..	1	..	..	..	..	..	..
E. NE	....	....	....	....	1	....	....	....	1	....	....	....	....	....	..	1	..	..	..	1	1	..	..	..
East	1	....	1	....	....	....	....	1	....	1	....	1	....	1	2	2	3	1	2	2	..	..	..	..
E. SE	....	....	....	....	....	1	1	....	2	2	3	2	4	2	4	3	2	2	..	1	1	..	..	..
SE	....	....	....	....	....	....	....	....	....	1	1	4	3	4	6	7	5	8	6	2	..	..	..	..
S. SE	....	....	....	....	....	....	....	....	....	....	1	....	1	2	..	..	2	1	2	..	1	..	..	..
South	....	....	....	....	....	....	1	....	....	....	....	....	....	1	..	..	..	1	..	..	1	1	..	..
S. SW	1	....	1	....	....	1	1	1	1	1	1	3	1	....	..	1	..	..	2	1	2	..	1	1
SW	1	2	1	2	2	1	3	2	3	4	2	2	5	3	1	1	2	..	..	1	..	2	1	2
W. SW	1	2	1	1	1	1	1	1	1	....	1	1	....	1	..	..	..	..	..	..	..	1	..	..
West	1	....	....	....	....	1	1	1	....	....	1	....	....	....	1	..	..	..	..	..	..	..	..	1
W. NW	1	....	2	....	....	....	....	1	2	2	....	....	....	....	..	..	..	..	..	..	..	..	..	..
NW	....	1	1	2	1	2	2	....	1	1	1	....	....	....	..	..	..	..	..	..	..	..	1	1
N. NW	1	....	1	1	1	1	....	1	....	....	....	....	....	....	..	..	..	..	1	..	..	1	1	1
Sums	7	5	8	7	7	9	13	12	15	15	15	15	15	15	14	15	14	14	14	8	8	8	6	7
Calms	7	9	6	7	7	6	1	3	0	0	0	0	0	0	0	0	0	0	0	6	6	6	8	7
AUGUST, 1861.																								
North	1	1	3	....	1	2	1	1	3	....	1	....	....	....	..	1	1	1	1	2	1	2	2	1
N. NE	1	3	1	2	....	2	2	2	1	4	3	....	....	....	..	..	..	1	2	1	1	1	1	1
NE	....	....	....	....	....	....	....	....	....	1	1	4	1	3	2	1	2	1	..	..	2	1	..	1
E. NE	....	....	....	....	....	....	....	1	....	....	1	....	2	....	1	2	1	1	..	..	..	..	..	..
East	....	....	....	....	....	....	....	1	....	....	....	1	....	....	2	..	..	1	2	1	2	1	1	1
E. SE	....	....	....	....	....	....	....	....	1	1	2	3	5	6	4	2	3	2	2	..	..	..	..	..
SE	....	....	....	....	....	....	....	....	1	2	3	4	5	5	5	8	7	6	4	2	1	..	..	..
S. SE	1	....	....	....	....	....	....	....	....	1	....	....	....	....	1	1	1	2	1	2	2	..	..	..
South	....	....	....	....	1	....	....	....	....	....	....	....	....	....	..	..	..	..	1	2	2	..	..	..
S. SW	1	....	1	1	1	1	....	1	2	....	....	1	....	....	..	..	1	..	..	1	1	1	..	..
SW	2	2	3	2	1	1	2	1	....	3	2	2	3	2	3	1	1	2	2	..	1	2	1	2
W. SW	2	3	2	1	1	2	2	1	3	3	2	1	....	1	1	2	1	1	..	..	1	..	1	..
West	....	....	1	3	2	2	2	3	2	1	1	1	1	1	..	1	..	..	1	1	..	1	1	..
W. NW	1	1	2	....	1	2	3	3	3	1	1	1	1	....	..	..	1	..	..	..	..	..	..	1
NW	1	....	1	1	1	1	2	2	1	1	2	1	1	1	..	..	..	..	..	..	..	..	..	..
N. NW	1	1	1	1	2	1	....	1	1	1	....	....	....	....	..	..	..	..	..	..	..	..	..	..
Sums	11	11	14	11	11	14	15	17	18	19	19	19	19	19	19	19	19	18	16	12	14	9	7	8
Calms	8	8	5	7	7	3	4	1	0	0	0	0	0	0	0	0	0	1	3	7	5	10	12	11

TABLE B B.—*Showing the duration of the wind, &c.*—Continued.

Points.	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
JUNE, JULY, AND AUGUST, 1861.																								
North	3	2	4	1	2	4	2	5	4	....	2	....	....	....	..	1	1	2	1	4	3	5	4	4
N. NE	3	6	3	4	4	6	6	8	6	7	6	2	1	1	1	1	3	4	6	2	3	4	4	3
NE	....	....	....	....	....	....	....	3	5	7	7	9	6	....	3	3	2	2	1	1	2	1	..	1
E. NE	....	....	....	....	1	....	....	2	1	1	....	1	2	1	2	2	2	3	..	1	..	..	..	..
East	1	....	....	....	1	1	2	2	3	1	1	3	1	1	4	5	4	2	6	2	3	1	1	1
E. SE	....	....	1	....	....	1	....	1	4	7	7	8	13	12	12	5	6	4	2	2	1	..	1	..
SE	....	....	....	....	....	....	....	1	5	6	10	11	11	17	16	24	18	21	11	5	2	1	..	1
S. SE	1	....	....	....	....	....	....	....	....	1	1	1	2	1	1	..	3	3	3	2	4	..	..	..
South	....	....	....	....	1	....	1	....	1	....	....	....	1	1	..	..	..	..	1	3	5	1	..	..
S. SW	2	1	2	2	1	1	1	2	2	2	1	4	1	1	2	2	2	2	4	2	2	2	2	3
SW	4	4	5	4	3	4	6	4	4	8	7	7	9	5	4	3	4	3	3	3	4	5	4	4
W. SW	7	7	5	3	3	3	3	2	4	3	2	2	....	2	2	3	2	2	..	..	1	1	2	4
West	3	1	2	2	3	4	3	2	2	1	1	1	1	1	..	1	..	..	1	1	..	1	1	1
W. NW	1	2	3	2	3	3	1	3	5	2	1	1	....	....	1	..	1	..	..	..	..	..	..	1
NW	2	2	3	6	5	6	5	3	2	2	3	1	1	1	..	..	..	..	..	..	..	..	2	..
N. NW	2	1	2	3	2	2	4	2	1	1	....	....	....	....	..	..	..	..	1	..	..	1	1	2
Sums	28	26	30	27	28	35	40	43	49	50	50	50	50	50	49	50	49	48	43	28	29	24	22	25
Calms	21	23	19	21	20	13	8	6	0	0	0	0	0	0	0	0	0	1	7	21	20	25	27	24
JUNE, 1862.																								
North	....	....	....	....	....	....	....	....	....	....	....	....	....	....	..	..	..	..	..	..	..	..	..	..
N. NE	2	4	2	2	2	2	6	5	5	4	2	2	2	2	2	3	4	3	2	3	2	2	2	2
NE	....	....	....	....	....	....	1	1	....	1	3	2	....	2	..	2	2	1	1	..	..	..	..	..
E. NE	....	....	....	....	....	....	....	1	1	1	1	1	1	....	3	2	..	..	..	..	..	..	..	..
East	....	....	....	....	....	....	....	....	....	....	....	....	2	....	..	..	..	..	..	..	..	..	..	..
E. SE	....	....	....	....	....	....	....	1	1	1	2	3	2	3	3	3	3	1	1	..	..	..	1	..
SE	....	....	....	....	....	....	....	....	....	....	....	....	1	1	1	..	..	1	..	..	..	..	..	..
S. SE	....	....	....	....	....	....	....	....	....	....	....	....	....	....	..	..	..	..	..	..	..	..	..	..
South	....	....	....	....	....	....	....	....	....	....	....	....	....	1	..	..	..	..	..	..	..	..	..	..
S. SW	....	....	....	....	....	....	....	....	....	....	....	1	1	1	2	1	..	..	..	..	..	..	..	..
SW	....	....	....	1	....	....	....	....	....	....	1	1	1	1	..	1	2	2	1	1	1	1	1	..
W. SW	1	1	2	....	1	1	2	3	3	4	2	2	2	....	..	..	..	..	1	1	1	1	2	1
West	....	1	....	....	....	1	1	....	....	....	2	....	....	1	1	..	2	1	..	1	1	1	..	2
W. NW	1	....	....	....	....	....	1	2	1	1	....	1	1	....	1	1	..	1	1	..	..	..	..	..
NW	....	....	....	1	....	1	....	....	1	1	....	1	1	2	1	1	..	..	..	..	..	1	..	..
N. NW	....	....	....	....	....	....	1	1	1	....	....	....	....	....	..	..	..	..	..	..	1	..	1	1
Sums	4	6	4	4	3	5	12	14	13	13	13	14	14	14	14	14	13	10	7	6	6	6	7	6
Calms	10	8	10	10	10	9	2	0	1	0	0	0	0	0	0	0	1	4	7	8	8	8	7	8
JULY, 1862.																								
North	....	....	....	....	....	....	....	....	2	1	....	1	....	....	..	..	..	..	..	..	..	..	..	..
N. NE	2	1	1	1	....	....	2	2	3	2	2	1	2	2	2	2	3	3	3	2	2	2	2	3
NE	1	....	....	....	....	....	2	1	1	1	....	....	....	....	..	1	..	1	..	..	..	..	..	..
E. NE	....	....	....	....	....	....	....	2	2	3	2	....	....	....	1	..	..	..	..	..	..	..	..	..
East	....	....	....	....	....	....	2	....	....	....	2	....	....	....	..	..	..	..	..	..	..	..	1	..
E. SE	1	1	....	....	....	....	....	2	1	3	3	5	2	2	3	1	..	..	..	..	1	..	..	..
SE	....	1	....	....	....	....	1	....	1	2	2	4	8	8	6	5	6	2	3	1	..	..	..	..
S. SE	....	....	....	1	....	....	....	....	....	....	1	....	....	....	1	3	4	6	3	1	..	1	..	1
South	....	....	1	....	1	....	....	....	....	....	1	....	....	2	..	1	..	1	..	1	1	..	..	..
S. SW	2	2	....	....	1	2	....	1	....	1	2	1	2	....	1	..	2	2	2	3	3	3	2	2
SW	....	....	1	1	....	2	4	2	2	2	1	3	2	2	2	3	2	1	2	1	2	1	3	..
W. SW	3	2	2	3	1	2	1	1	2	1	1	1	2	2	1	2	1	1	2	2	1	..	2	3
West	....	1	....	1	1	2	2	2	1	1	....	....	....	....	1	..	..	..	..	..	1	1	..	..
W. NW	2	2	1	2	2	1	....	2	3	1	3	3	3	3	3	3	2	2	1	1	2	3	3	3
NW	2	1	4	1	2	4	3	2	1	4	2	4	1	1	..	..	2	3	3	1	..	1	1	1
N. NW	....	....	....	....	....	....	2	4	1	1	1	....	1	1	2	2	1	..	..	..	1	..	1	..
Sums	13	11	10	10	8	13	19	21	20	23	23	23	23	23	23	23	23	22	19	13	14	12	15	13
Calms	10	12	13	13	15	10	4	2	2	0	0	0	0	0	0	0	0	1	4	10	9	11	8	10

TABLE B B.—*Showing the duration of the wind, &c.*—Continued.

Points.	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
AUGUST, 1862.																								
North	....	....	1	....	....	....	....	2	2	1	....	....	....	....	..	..	..	..	..	..	..	1	2	..
N. NE	1	1	1	2	2	2	2	2	3	2	2	2	1	1	..	..	1	1	1	2	1	2	1	1
NE	1	....	....	....	....	....	1	1	1	1	2	1	2	3	3	4	2	2	2	..	1	..	..	..
E. NE	1	2	1	1	2	1	1	....	....	1	1	2	....	....	2	..	1	..	1	..	..	..	..	..
East	....	....	....	....	....	1	1	1	....	....	....	....	2	2	..	1	..	..	..	..	..	..	..	..
E. SE	....	1	....	....	....	....	....	1	....	....	1	....	1	2	1	3	2	..	..	..	..	..	..	..
SE	....	....	....	....	....	....	....	1	4	5	6	6	5	5	7	5	3	4	1	1	2	2	1	1
S. SE	1	1	1	....	....	....	1	....	1	....	....	....	....	....	1	..	1	1	..	..	1	..	..	..
South	1	....	....	1	1	2	....	1	....	....	....	....	1	1	..	..	1	1	..	1	..	1	..	..
S. SW	1	3	1	1	....	....	2	1	....	2	....	1	....	1	1	1	1	..	1	2	3	4	3	2
SW	2	3	3	2	1	1	2	3	4	4	5	4	3	3	3	3	5	4	1	..	..	..	..	3
W. SW	2	....	....	....	....	2	3	3	1	....	....	....	....	....	..	..	..	1	..	..	1	..	3	1
West	....	....	....	....	....	....	....	....	2	1	....	....	2	....	..	..	..	1	1	1	1	..	1	2
W. NW	1	2	2	3	3	1	2	1	1	1	2	3	2	3	2	4	2	1	1	2	1	3	2	1
NW	1	1	1	1	1	2	2	3	1	3	1	1	1	1	2	..	..	1	1	..	2	3	1	..
N. NW	1	1	1	....	....	....	1	....	1	....	1	1	1	....	..	..	..	..	..	..	..	..	1	1
Sums	13	15	12	11	10	12	18	20	21	21	21	21	21	22	22	21	20	17	10	9	13	16	15	12
Calms	9	7	10	11	12	9	4	2	1	0	0	0	0	0	0	1	2	5	11	12	9	6	7	10
JUNE, JULY, AND AUGUST, 1862.																								
North	....	....	1	....	....	....	....	2	4	2	....	1	....	....	..	..	..	..	..	..	..	1	2	.
N. NE	5	6	4	5	4	4	10	9	11	8	6	5	5	5	4	5	8	7	6	7	5	6	5	6
NE	2	....	....	....	....	....	4	3	2	3	5	3	2	5	3	7	4	4	3	..	1	..	..	..
E. NE	1	2	1	1	2	1	1	3	3	5	4	3	1	....	6	2	1	..	1	..	..	..	..	..
East	....	....	....	....	....	1	3	1	....	....	2	....	4	2	..	1	..	..	..	..	..	..	1	..
E. SE	1	2	....	....	....	....	....	4	2	4	6	8	5	7	7	7	5	1	1	..	1	..	1	..
SE	....	1	....	....	....	....	1	1	5	7	8	10	14	14	14	10	9	7	4	2	2	2	1	1
S. SE	1	1	1	1	....	....	1	....	1	....	1	....	....	....	2	3	5	7	3	1	1	1	..	1
South	1	....	1	2	2	2	....	1	....	....	1	....	1	4	..	1	1	2	..	2	1	1	..	..
S. SW	3	5	1	....	1	2	2	2	....	3	2	3	3	2	4	2	3	2	3	5	6	7	5	4
SW	2	3	4	4	1	3	6	5	6	6	7	8	6	6	5	7	9	7	4	2	3	2	4	3
W. SW	6	3	4	3	2	5	6	7	6	5	3	3	4	2	1	2	1	2	3	3	3	1	7	5
West	....	2	....	1	1	3	3	2	3	2	2	....	2	1	2	..	2	2	1	2	3	2	1	4
W. NW	4	4	3	5	5	2	3	5	5	3	5	7	6	6	6	8	4	4	3	3	3	6	5	4
NW	3	2	5	3	3	7	5	5	3	8	3	6	3	4	3	1	2	4	4	1	2	5	2	1
N. NW	1	1	1	....	....	....	4	5	3	1	2	1	2	1	2	2	1	..	..	..	2	..	3	2
Sums	30	32	26	25	21	30	49	55	54	57	57	58	58	59	59	58	56	49	36	28	33	34	37	31
Calms	29	27	33	34	37	28	10	4	2	0	0	0	0	0	0	1	3	10	22	30	26	25	22	28
JUNE, 1863.																								
North	....	....	....	....	....	....	....	2	1	1	....	....	....	....	..	..	..	..	..	..	..	1	..	..
N. NE	3	4	2	2	3	3	1	1	2	....	1	....	....	1	..	..	..	1	2	2	1	2	2	2
NE	1	....	1	1	1	1	4	3	3	1	1	1	1	....	2	2	2	2	1	2	2	..	..	1
E. NE	....	....	....	....	....	2	2	2	2	3	2	3	2	2	1	1	2	2	2	1	1	1	..	..
East	....	....	....	....	....	....	....	....	....	1	....	....	....	....	..	..	..	..	..	..	..	..	..	..
E. SE	....	....	....	....	....	1	1	1	4	6	4	3	3	3	2	..	2	..	..	..	..	..	..	..
SE	....	....	....	....	....	....	3	3	3	4	8	9	10	10	11	11	8	7	1	..	..	..	..	1
S. SE	....	1	1	1	1	....	....	1	....	....	1	....	....	....	..	1	..	1	..	1	1	..	..	..
South	....	....	....	....	....	....	....	1	....	....	....	1	1	....	..	..	..	..	..	..	..	..	1	..
S. SW	....	....	....	....	....	....	....	....	1	1	....	....	....	1	..	..	..	..	1	1	..	..	..	..
SW	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	2	2	1	..	..	1	..	..	..
W. SW	3	3	2	1	1	1	1	1	1	2	1	....	....	....	..	..	..	1	2	1	1	2	2	3
West	....	....	....	1	....	....	....	....	1	....	....	1	....	1	1	..	1	1	..	..	..	..	..	..
W. NW	....	....	1	2	2	2	2	1	1	1	1	1	2	1	1	2	1	1	2	1	2	..	..	2
NW	....	....	....	....	....	....	....	....	....	....	1	....	....	....	..	1	1	..	..	1	..	1	2	1
N. NW	....	....	....	....	....	....	....	....	....	....	....	1	1	1	1	..	..	1	..	..	1	1	1	..
Sums	7	8	7	8	8	10	14	16	19	20	20	20	20	20	20	20	19	18	11	10	10	8	8	10
Calms	13	12	13	12	12	10	6	4	1	0	0	0	0	0	0	0	1	2	9	10	10	12	12	10

TABLE B B.—*Showing the duration of the wind, &c.*—Continued.

Points.	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
JULY, 1863.																								
North	....	....	....	....	....	1	1	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	1
N. NE	....	....	....	1	2	3	2	3	1	....	1	....	....	....	....	....	....	....	....	....	....	....	1	....
NE	2	2	1	1	1	1	5	4	4	5	2	2	2	2	3	3	2	3	3	4	2	1	....	....
E. NE	....	1	....	1	1	1	....	....	2	2	2	2	2	2	1	1	3	2	3	1	2	1	....	....
East	....	....	....	....	....	....	....	....	....	....	3	1	....	....	1	2	....	....	....	1	1	....	....	....
E. SE	2	1	1	1	1	1	....	3	1	2	2	2	3	3	2	....	2	....	1	3	2	2	....	1
SE	....	....	....	....	....	1	1	2	5	6	6	9	9	9	7	7	8	7	4	3	1	2	2	1
S. SE	1	....	....	....	....	....	....	1	1	1	....	....	....	....	1	2	....	1	2	1	....	....	2	....
South	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....
S. SW	....	2	1	1	....	1	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	2
SW	2	1	1	1	3	....	1	1	1	1	1	1	1	1	....	1	....	....	....	1	2	1	1	1
W. SW	....	....	....	....	1	1	....	1	2	1	....	....	....	1	1	....	....	2	1	....	1	1	1	1
West	....	....	1	1	....	....	1	2	....	....	....	2	1	....	2	1	3	....	....	....	....	....	....	....
W. NW	2	3	1	2	1	1	1	1	2	....	3	1	1	1	3	2	1	....	1	....	1	1	....	1
NW	....	....	....	....	....	1	3	1	1	....	1	1	2	2	....	2	2	1	....	....	1	1	1	....
N. NW	2	1	2	2	1	3	....	1	1	3	....	....	....	....	....	....	....	1	....	1	....	....	1	1
Sums	11	11	8	11	11	15	16	20	21	21	21	21	21	21	21	21	21	18	15	15	14	11	9	9
Calms	10	10	13	10	10	6	5	1	0	0	0	0	0	0	0	0	0	3	6	6	7	10	12	12
AUGUST, 1863.																								
North	....	1	....	....	....	....	1	....	2	....	....	....	....	....	....	....	....	1	....	....	1	1	....	....
N. NE	1	....	1	1	3	3	....	1	....	....	....	....	....	....	....	....	1	....	....	1	....	....	2	2
NE	2	3	....	2	1	1	3	2	2	2	1	1	1	1	2	1	5	6	5	3	2	4	1	1
E. NE	....	....	....	....	....	....	....	1	1	1	2	3	3	3	1	2	....	....	1	1	1	1	....	....
East	....	....	1	....	....	....	....	....	....	....	....	....	....	1	3	....	....	....	....	1	1	....	....	....
E. SE	....	....	....	....	....	....	....	....	....	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....
SE	....	....	....	1	1	1	2	1	2	2	5	7	6	5	4	3	3	4	3	3	2	2	1	....
S. SE	1	....	....	1	2	2	....	....	1	1	1	....	2	4	4	9	6	5	1	2	1	1	2	1
South	....	....	....	1	....	....	....	....	2	....	....	....	....	....	....	....	....	1	1	....	....	....	....	....
S. SW	1	1	1	1	1	1	2	4	1	....	1	2	1	2	2	1	1	1	3	2	5	3	1	....
SW	7	6	4	3	1	1	3	1	2	4	3	3	5	2	2	1	1	1	2	3	2	3	7	6
W. SW	2	1	2	3	4	4	2	5	4	3	3	4	....	....	....	....	....	1	2	....	....	....	2	2
West	1	1	1	....	....	2	2	2	1	1	4	1	1	1	1	2	1	....	....	....	....	1	....	....
W. NW	....	1	1	1	1	....	4	2	2	3	1	1	3	3	1	1	....	1	2	1	1	....	....	....
NW	2	2	1	2	5	3	2	....	1	1	2	2	....	2	3	4	4	2	1	1	1	1	....	1
N. NW	2	2	2	2	1	....	2	4	3	2	1	....	2	....	1	....	2	1	....	....	....	....	2	....
Sums	19	18	14	18	20	18	23	22	24	22	24	24	24	24	24	24	24	24	21	18	17	17	18	13
Calms	5	6	10	6	4	6	1	2	0	2	0	0	0	0	0	0	0	0	3	6	7	7	6	11
JUNE, JULY, AND AUGUST, 1863.																								
North	1	....	....	....	....	1	3	2	3	1	....	....	....	....	....	....	....	2	....	....	1	2	....	1
N. NE	4	4	3	4	8	9	2	5	3	....	2	....	....	1	....	....	1	1	2	3	1	2	5	4
NE	5	5	2	4	3	3	12	9	9	8	4	4	4	3	7	6	9	11	9	9	6	5	1	2
E. NE	....	1	....	1	1	3	2	3	5	7	6	8	7	7	3	4	5	4	6	3	4	2	....	....
East	....	....	1	....	....	....	....	....	....	1	3	1	....	1	4	2	....	....	....	2	2	....	....	....
E. SE	2	1	1	1	1	2	1	4	5	10	6	5	6	6	4	....	4	....	1	3	2	2	....	1
SE	....	....	....	1	1	2	6	6	10	12	19	25	25	24	22	21	19	18	8	6	3	4	3	2
S. SE	2	1	1	2	3	2	....	2	2	2	2	....	2	4	5	12	....	7	3	4	2	1	4	1
South	....	....	....	1	....	....	....	1	2	....	....	1	1	....	....	....	....	1	1	....	1	....	1	....
S. SW	1	3	2	2	1	2	3	4	2	2	1	2	1	3	2	1	1	1	4	3	5	4	1	2
SW	9	7	5	4	4	1	4	2	3	5	4	4	6	3	3	4	3	2	2	4	5	4	8	7
W. SW	5	4	4	4	6	6	3	7	7	6	4	4	....	1	1	....	....	4	5	1	2	3	5	6
West	1	1	2	2	....	2	3	4.	2	1	4	4	2	2	4	3	5	1	....	....	....	1	....	....
W. NW	2	4	3	5	4	3	7	4	5	4	5	3	6	5	5	5	2	2	5	2	4	1	....	3
NW	2	2	1	2	5	4	5	1	2	1	4	3	2	4	3	7	7	3	....	2	2	3	3	2
N. NW	4	3	4	4	2	3	2	5	4	5	1	1	3	1	2	....	2	3	....	1	1	1	4	1
Sums	37	37	29	37	39	43	53	58	64	63	65	65	65	65	65	65	64	60	47	43	41	36	35	32
Calms	28	28	36	28	26	22	12	7	1	2	0	0	0	0	0	0	1	5	18	22	24	29	30	33

TABLE B B.—*Showing the duration of the wind, &c.*—Continued.

Points.	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
JUNE, 1864.																								
North	....	....	....	1	....	....	....	....	....	....	....	....	....	2	1	1	1	1	1	2	1	1	1	1
N. NE	3	3	3	2	3	2	2	3	5	3	2	2	2	2	2	3	3	2	1	1	..	..	1	2
NE	....	....	....	....	1	3	3	2	2	2	2	2	3	1	2	1	..	1	1	..	2	1	1	..
E. NE	....	....	....	....	....	....	1	1	2	....	3	3	2	....	..	..	1	..	..	..	..	..	..	..
East	....	....	....	....	1	....	....	2	....	2	2	....	....	2	..	..	..	..	1	..	..	..	..	..
E. SE	....	....	....	....	....	....	....	1	5	5	1	7	7	7	8	7	6	5	2	..	..	..	..	..
SE	....	....	....	....	....	....	....	1	....	....	....	....	....	....	1	2	2	1	..	1	..	..	..	..
S. SE	1	1	1	....	....	....	....	....	....	....	4	....	....	....	..	..	..	..	..	..	1	1	..	..
South	....	....	....	....	....	....	....	....	....	1	....	....	....	....	..	..	..	..	..	..	..	..	..	..
S. SW	....	....	....	....	1	2	2	2	2	1	1	1	1	1	1	..	..	1	1	..	..	..	..	..
SW	1	1	1	....	....	....	1	....	2	2	2	1	2	2	1	2	2	1	1	1	2	2	1	2
W. SW	1	2	2	2	1	1	3	3	1	1	1	2	1	1	2	2	2	2	2	1	..	..	1	1
West	....	....	....	....	1	....	....	....	....	....	....	....	....	....	..	..	..	..	..	1	..	..	..	..
W. NW	....	....	....	....	....	1	1	....	....	....	....	....	....	....	..	..	..	..	..	..	1	1	..	..
NW	2	1	1	1	1	....	1	1	....	....	....	....	....	....	..	..	..	..	..	..	1	..	1	1
N. NW	....	....	....	....	....	1	1	....	....	1	....	....	....	....	..	..	..	..	..	..	..	1	1	1
Sums	8	8	8	6	9	10	15	16	19	18	18	18	18	18	18	18	17	14	10	7	8	7	7	8
Calms	11	11	11	12	8	7	4	3	0	0	1	1	1	1	1	1	2	3	7	10	11	12	12	11
JULY, 1864.																								
North	1	1	2	....	....	....	....	1	....	....	....	....	....	....	..	..	..	..	..	..	..	1	..	..
N. NE	1	1	1	2	3	3	2	2	3	3	2	....	1	1	1	1	1	3	2	3	2	..	1	1
NE	....	1	....	....	....	....	1	2	1	1	1	2	2	3	4	2	3	..	..	..	..	..	..	..
E. NE	....	....	....	....	....	....	2	1	2	2	3	2	1	1	..	2	1	1	1	..	..	..	..	..
East	....	....	....	....	....	....	....	....	1	....	....	....	....	....	..	..	..	..	..	..	..	..	..	..
E. SE	....	....	1	....	....	....	....	3	2	5	5	8	10	6	8	4	6	5	3	..	..	1	2	1
SE	....	....	....	....	....	1	2	1	2	....	2	2	1	4	3	4	4	5	3	2	6	1	..	..
S. SE	....	....	....	....	....	....	1	....	....	....	....	....	....	....	..	1	1	..	1	1	..	1	2	..
South	....	1	....	....	....	....	....	1	1	1	1	....	1	....	1	..	..	..	2	1	..	..	1	..
S. SW	....	....	....	1	....	....	....	....	1	1	....	....	....	....	1	1	1	1	1	2	1	1	..	1
SW	3	1	1	....	1	1	1	2	1	2	2	2	1	2	1	2	1	2	2	1	2	6	6	7
W. SW	3	3	4	4	4	3	3	4	5	3	2	2	1	1	1	2	3	2	1	1	..	..	1	2
West	1	....	....	....	....	....	1	1	1	1	1	3	5	5	..	1	..	..	..	..	..	..	..	..
W. NW	2	2	....	....	....	1	2	3	4	4	5	2	....	....	2	1	2	..	..	..	..	..	1	..
NW	2	1	2	1	1	....	1	1	....	1	....	....	....	1	1	1	..	2	..	..	..	..	..	..
N. NW	....	1	....	1	1	1	1	....	....	....	....	1	1	....	..	..	..	..	1	1	1	..	..	..
Sums	13	12	11	9	10	10	17	22	24	24	24	24	24	24	23	22	23	21	17	12	12	11	14	12
Calms	11	12	12	14	13	12	6	2	0	0	0	0	0	0	0	1	0	2	5	11	11	13	10	12
AUGUST, 1864.																								
North	1	....	....	2	1	1	....	....	....	....	....	....	....	....	..	..	..	1	..	..	..	..	..	..
N. NE	3	3	1	....	2	3	6	8	7	5	4	4	6	3	4	4	6	7	5	3	3	2	2	1
NE	....	1	1	1	....	....	....	....	2	4	3	3	3	6	3	3	2	1	..	1	1	..	..	..
E. NE	....	....	....	....	....	....	....	....	....	1	3	5	3	2	4	3	3	..	2	3	..	..	1	1
East	....	....	....	....	....	....	....	....	1	1	2	....	....	1	..	2	..	1	..	..	..	..	..	1
E. SE	....	....	....	....	....	....	1	1	3	3	4	7	7	8	8	5	3	1	..	..	2	1	1	1
SE	....	....	....	....	....	....	....	....	....	2	1	....	....	2	2	3	6	6	4	2	..	..	1	..
S. SE	1	1	1	1	1	1	....	1	1	1	1	2	1	....	1	..	2	1	2	1	1	..	1	2
South	1	....	....	1	1	1	1	....	....	1	2	1	3	....	..	3	1	..	..	2	..	1	1	2
S. SW	3	3	2	....	1	1	2	2	2	....	1	....	....	1	2	1	..	1	1	1	3	3	3	2
SW	....	....	1	2	....	....	2	2	3	3	....	1	....	1	..	..	1	..	..	..	1	..	..	..
W. SW	1	1	2	2	2	3	1	1	1	....	1	....	....	....	..	..	..	..	..	..	..	..	..	1
West	1	1	....	....	....	....	....	....	....	....	....	....	....	....	..	..	..	..	..	..	..	..	..	..
W. NW	1	1	2	....	1	1	2	2	1	....	1	1	....	....	1	1	..	..	..	..	..	..	..	..
NW	1	2	2	4	....	2	3	2	2	3	2	1	2	1	..	..	..	1	1	1	2	2	1	2
N. NW	3	1	4	2	5	3	1	1	1	....	....	....	....	....	..	..	1	..	2	3	2	2	3	3
Sums	16	14	16	15	14	16	19	20	24	24	25	25	25	25	25	25	25	20	17	17	15	11	14	16
Calms	9	11	9	10	11	9	6	5	1	1	0	0	0	0	0	0	0	5	8	7	10	14	11	9

TABLE B B.—*Showing the duration of the wind, &c.*—Continued.

Points.	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
JUNE, JULY, AND AUGUST, 1864.																								
North	1	1	2	3	1	1	....	1	....	....	....	....	....	2	1	1	1	2	1	2	1	2	1	1
N. NE	7	7	5	4	8	3	10	13	15	11	8	6	9	6	7	8	10	12	8	7	5	2	4	4
NE	....	2	1	1	1	3	4	4	5	7	6	7	8	10	9	6	5	2	1	1	3	1	1	..
E. NE	....	....	....	....	....	....	3	2	4	3	9	10	6	3	4	5	5	1	3	3	..	..	1	1
East	....	....	....	....	1	....	....	2	2	3	4	....	....	3	..	2	..	1	1	..	..	..	..	1
E. SE	....	....	1	....	....	....	1	5	10	13	10	22	24	21	24	16	15	11	5	..	2	2	3	2
SE	....	....	....	....	....	1	2	2	2	2	3	2	1	6	6	9	12	12	7	5	6	1	1	..
S. SE	2	2	2	1	1	1	1	1	1	1	5	2	1	....	1	1	3	1	3	2	2	2	3	2
South	2	1	....	1	1	1	1	1	1	3	3	1	4	....	1	3	1	..	2	3	..	1	2	2
S. SW	3	3	2	1	2	3	4	4	5	2	2	1	1	2	4	2	1	3	3	3	4	4	3	3
SW	4	2	3	2	1	1	4	4	6	7	4	4	3	5	2	4	4	3	3	2	5	8	7	9
W. SW	5	6	8	8	7	7	7	8	7	4	4	4	2	2	3	4	5	4	3	2	..	..	2	4
West	2	1	....	....	1	....	1	1	1	1	1	3	5	5	..	1	..	..	..	1	..	..	..	..
W. NW	3	3	2	....	1	3	5	5	5	4	6	3	....	....	3	2	2	..	..	..	1	1	1	..
NW	5	4	5	6	2	2	5	4	2	4	2	1	2	2	1	1	..	3	1	1	3	2	2	3
N. NW	3	2	4	3	6	5	3	1	1	1	....	1	1	....	..	..	1	..	3	4	3	3	4	4
Sums	37	34	35	30	33	36	51	58	67	66	67	67	67	67	66	65	65	55	44	36	35	29	35	36
Calms	31	34	34	35	31	22	12	8	1	1	1	1	1	1	1	2	2	10	20	28	32	39	33	32
JUNE, 1862, AT CLEVELAND, OHIO.																								
North	....	1	....	....	....	....	....	....	....	....	....	....	....	1	..	..	..	..	..	..	..	..	..	..
N. NE	2	1	2	....	....	....	....	....	....	....	....	....	2	1	2	..	..	..	..	..	..	..	..	..
NE	1	1	....	1	1	....	....	....	....	....	....	....	1	1	..	1	1	..	..	..	..	..	..	..
E. NE	....	....	....	....	....	....	....	....	....	....	....	....	....	....	..	..	..	..	..	..	..	..	..	..
East	....	1	1	....	....	1	....	....	....	....	....	....	....	1	1	..	..	1	..	..	..	..	..	..
E. SE	....	....	....	....	....	....	....	....	....	....	....	....	....	....	..	..	..	..	..	..	..	..	..	..
SE	1	....	....	....	....	....	1	....	....	....	....	....	1	....	..	..	..	..	..	..	..	..	..	..
S. SE	....	....	....	....	....	....	....	....	2	2	2	3	....	....	..	..	..	..	1	..	2	2	2	3
South	....	....	....	....	....	....	....	....	....	....	1	....	....	....	..	..	..	..	..	..	..	..	1	..
S. SW	....	....	....	....	1	1	1	1	1	3	3	3	....	....	..	..	1	1	1	1	1	3	3	3
SW	....	1	1	1	....	....	....	....	1	1	1	....	....	1	1	1	..	..	..	..	1	1	1	..
W. SW	....	....	....	....	....	....	....	....	....	....	....	....	....	....	..	..	..	..	..	..	..	..	..	..
West	....	....	....	....	....	....	....	....	....	....	....	....	....	....	..	..	..	..	..	..	..	..	..	..
W. NW	1	1	2	1	1	1	2	1	1	1	1	1	1	1	2	1	1	1	2	1	1	1	1	1
NW	1	1	....	2	1	1	....	....	....	....	....	....	1	1	..	2	1	1	..	..	..	..	..	..
N. NW	2	....	....	1	2	2	1	....	....	....	....	....	2	....	..	1	2	2	1	..	..	..	..	..
Sums	8	7	6	6	6	6	5	2	5	7	8	7	8	7	6	6	6	6	5	2	5	7	8	7
Calms	4	5	6	6	6	6	7	10	7	5	4	5	4	5	6	6	6	6	7	10	7	5	4	5
JULY, 1862.																								
North	....	....	....	....	....	....	....	....	....	2	....	....	1	1	..	..	..	..	..	..	..	..	..	..
N. NE	1	....	....	....	....	....	....	....	1	1	3	2	3	3	2	2	1	1	..	..	1	1	1	1
NE	....	....	....	....	....	....	....	1	....	....	....	....	....	....	1	1	2	3	1	..	..	..	..	2
E. NE	....	....	....	....	....	....	....	....	....	....	....	....	....	....	..	..	..	..	..	1	..	..	..	..
East	1	1	....	....	....	....	....	....	....	....	....	....	....	....	1	..	..	..	..	..	..	..	1	..
E. SE	....	....	....	....	....	....	....	....	....	....	....	....	....	....	..	..	..	..	..	..	..	..	..	..
SE	....	....	....	....	....	....	....	....	....	....	....	....	....	....	..	..	..	..	..	..	..	..	..	..
S. SE	8	10	9	7	8	8	6	4	2	1	....	....	....	1	1	2	2	2	2	2	6	10	9	9
South	....	....	....	....	....	....	1	1	1	....	....	1	1	....	..	..	..	..	..	..	..	..	1	1
S. SW	2	2	5	5	4	4	5	....	1	....	....	....	....	....	..	..	..	..	1	3	2	2	2	2
SW	....	1	....	2	3	3	2	6	3	2	1	1	2	2	2	2	2	1	1	..	1	2	1	..
W. SW	1	1	1	....	....	....	1	3	3	4	3	2	....	....	..	1	..	1	..	1	1	..	1	1
West	....	1	1	....	....	1	....	....	2	....	....	....	....	1	1	..	1	..	..	..	..	..	..	..
W. NW	1	....	....	....	....	....	....	....	1	3	3	4	6	3	2	3	2	1	..	..	1	..	..	..
NW	....	....	1	1	1	....	1	1	1	....	1	2	....	....	..	..	..	..	..	..	..	..	..	..
N. NW	1	1	....	....	....	....	....	1	1	....	1	4	3	3	3	2	1	..	1	..	..	..	..	..
Sums	15	17	17	15	16	16	16	17	16	13	12	16	16	14	13	13	11	9	6	7	12	15	16	16
Calms	4	2	2	4	3	3	3	2	3	6	7	3	3	5	6	6	8	10	13	12	7	4	3	2

TABLE B B.—*Showing the duration of the wind, &c.*—Continued.

Points.	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
AUGUST, 1862.																								
North												2	2	1										
N. NE	1	1							1	1	3	3	3	4	5	3	1							
NE			1											1	1	3	5	3	1					
E. NE																		3	4	2				
East																				1				
E. SE	1		1																	2	2			
SE		1		1	1	1	1								1	1	1				1	2		
S. SE	12	12	12	12	12	12	10	7	2	2	2	1				1	1	2	3	3	5	9	11	12
South							1	1	2			1	1	1	1							2		
S. SW	1	1	1		1	1	1	2		1	1	1				1	1	1	3	4	3	2	3	1
SW				1			1	1	2				3	3	3	1	2	1	1		1	1		1
W. SW								1	2	3	1	1			1	2	1	1					2	
West									1		1	2	1											
W. NW								1		1	2	1	1											1
NW												1	1	2										
N. NW											1		2	3	2	2	2	2						
Sums	15	15	15	14	14	14	14	13	10	8	11	13	14	15	14	14	14	13	12	12	12	16	16	15
Calms	1	1	1	2	2	2	2	3	6	8	5	3	2	1	2	2	2	3	4	4	4	0	0	0
SEPTEMBER, 1862.																								
North		1							1	1	4	3					1	2						
N. NE			1	1	1	1	1	1				1	2	3	1				1	1				1
NE	2									1		1		2	3	4	2							
E. NE									1	1	1		1				2	3	2					
East								1	1											2				
E. SE		1						1											1					
SE		1	2	1	1	1	1													1		1		
S. SE	5	5	5	5	6	6	6	5	5	1									1	3	6	4	4	5
South			1							2										1	1	1		1
S. SW				1							1	1						1	1				1	
SW										1	1		1		1		1						1	
W. SW												1	1	1										
West																								
W. NW	1											1	1											
NW										1	1				1	1								
N. NW													2	2	1	2	1							
Sums	8	8	9	8	8	8	8	8	8	8	8	8	8	8	7	7	7	6	6	8	7	6	6	7
Calms	1	1	0	1	1	1	1	1	1	1	1	1	1	1	2	2	2	3	3	1	2	2	2	2
JUNE, 1864, AT THUNDER BAY, MICH.																								
North	4	5	5	5	5	5	4	5	5	5	7	6	4	5	4	4	4	4	4	4	3	4	4	2
N. NE																								
NE	2	1	2	2	3	1			1		2	3	5				1		1				1	2
E. NE																								
East	1	1		1		1	2	2	2	3	2	2	1	2	1	1	1	1	1	1	2	3	1	1
E. SE																								
SE	1		1	1	1	1	1	1	1	2	1	4	6	5	6	5	4	4	2	1	1	1	1	2
S. SE									1	1														
South	5	5	5	3	4	3	3	4	5	6	6	5	5	8	6	8	6	8	8	6	5	6	6	6
S. SW																								
SW		1	1	1	2	1	1	1	1			1			2	2	2	2	2	1	1			1
W. SW						1																1	1	1
West	4	2	3	2			2	2	2	2	3					1	1				1		2	2
W. NW		2	1	1	2	2	1	1	1					1	1			1	1		1	1		
NW	2	1	2	2	3	4	6	4	2	2		1	1											2
N. NW																				1				
Sums	19	18	20	18	20	19	20	20	21	21	21	22	22	21	20	21	19	20	19	14	14	16	16	19
Calms	3	4	2	4	2	3	2	2	1	1	1	0	0	1	2	1	3	2	3	8	8	6	6	3

TABLE B B.—*Showing the duration of the wind, &c.*—Continued.

Points.	1	2	2	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
JULY, 1864.																								
North	3	4	4	2	1	2	4	4	5	4	3	4	3	5	5	7	7	7	6	7	7	6	4	4
N. NE	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
NE	....	2	2	3	2	1	1	....	....	1	1	1	1	....	....	....	....	....	....	....	....	....	....	....
E. NE	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
East	1	....	....	....	2	1	1	1	1	2	2	4	5	3	3	1	1	1	1	1	1	1	....	....
E. SE	....	....	....	....	....	....	....	....	....	....	1	1	1	1	....	....	....	....	....	....	....	....	....	....
SE	....	....	....	....	....	1	....	2	2	3	7	6	6	8	8	9	8	8	7	5	3	1	2	2
S. SE	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
South	4	3	2	3	3	4	4	5	6	5	5	5	5	5	4	3	6	5	6	7	6	7	5	4
S. SW	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	1	1	....	....	....	....	....
SW	1	2	2	2	2	1	1	1	....	1	....	....	....	....	2	1	....	....	....	....	1	1	1	1
W. SW	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
West	4	3	3	2	2	2	3	2	2	1	1	1	1	1	1	....	....	....	....	1	1	1	1	2
W. NW	....	....	....	1	1	1	1	1	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
NW	6	7	8	9	10	9	6	6	5	6	3	1	1	....	....	1	1	1	1	....	....	1	2	3
N. NW	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Sums	19	21	22	22	23	23	21	22	22	23	23	23	23	23	23	23	23	23	22	21	19	18	15	16
Calms	4	2	1	1	0	0	2	1	1	0	0	0	0	0	0	0	0	0	1	2	4	5	8	7
AUGUST, 1864.																								
North	7	6	3	3	2	2	2	3	3	4	4	4	3	3	3	4	4	4	4	3	3	3	4	4
N. NE	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
NE	....	1	1	1	1	....	....	....	1	1	1	2	3	2	1	1	1	....	....	1	1	....	....	1
E. NE	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
East	....	....	1	1	1	2	2	2	1	1	1	1	1	2	2	3	2	1	1	1	....	....	1	....
E. SE	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
SE	1	1	1	....	....	....	....	....	....	1	1	1	2	2	3	2	3	3	2	2	2	1	1	1
S. SE	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
South	2	3	3	3	3	3	3	3	1	1	4	6	5	5	5	5	5	5	5	4	3	....	....	1
S. SW	1	1	1	....	1	1	1	1	1	1	1	....	....	....	....	....	....	....	....	....	....	1	1	1
SW	1	1	1	....	....	....	....	....	1	1	....	....	1	1	....	....	....	1	1	1	1	1	1	1
W. SW	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
West	3	3	3	4	4	4	3	2	2	4	2	2	1	1	....	....	....	....	....	....	....	1	3	5
W. NW	....	....	....	....	1	1	1	1	1	1	1	....	....	....	1	....	....	....	....	....	....	....	....	....
NW	2	2	3	4	5	5	6	6	6	3	3	2	2	2	3	3	3	3	2	3	4	4	3	3
N. NW	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Sums	17	18	17	16	18	18	18	18	18	18	18	18	18	18	18	18	18	17	15	15	14	11	14	17
Calms	1	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	3	4	7	4	1
JUNE, JULY, AND AUGUST, 1864.																								
North	14	15	12	10	8	9	10	12	13	13	14	14	10	13	12	15	15	15	14	14	13	13	12	10
N. NE	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
NE	2	4	5	6	6	2	1	....	2	2	4	6	9	2	1	1	2	....	1	1	1	....	1	3
E. NE	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
East	2	1	1	2	3	4	5	5	4	6	5	7	7	7	6	5	4	3	3	3	3	4	2	1
E. SE	....	....	....	....	....	....	....	....	....	....	1	1	1	1	....	....	....	....	....	....	....	....	....	....
SE	2	1	2	1	1	2	1	3	3	6	9	11	14	15	17	16	15	15	11	8	6	3	4	5
S. SE	....	....	....	....	....	....	....	....	1	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....
South	11	11	10	9	10	10	10	12	12	12	15	16	15	18	15	16	17	18	19	17	14	13	11	11
S. SW	1	1	1	....	1	1	1	1	1	1	1	....	....	....	....	1	....	1	1	....	....	1	1	1
SW	2	4	4	3	4	2	2	2	2	2	....	1	1	1	4	3	2	3	3	2	3	2	2	3
W. SW	....	....	1	....	....	1	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	1	1	1
West	11	8	9	8	6	6	8	6	6	7	6	3	2	2	1	1	1	....	....	1	2	2	6	9
W. NW	....	2	1	2	4	4	3	3	3	1	1	....	....	1	2	....	....	1	1	....	1	1	....	....
NW	10	10	13	15	18	18	18	16	13	11	6	4	4	2	3	4	4	4	3	3	4	5	5	8
N. NW	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....
Sums	55	57	59	56	61	60	59	60	61	62	62	63	63	62	61	62	60	60	56	50	47	45	45	52
Calms	8	6	4	7	2	3	4	3	2	1	1	0	0	1	2	1	3	3	7	13	16	18	18	11

TABLE B B.—*Showing the duration of the wind, &c.*—Continued.

Points.	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
JUNE, 1865.																								
North	2	3	3	2	2	2	2	3	4	5	4	4	3	2	2	2	1	1	3	4	4	2	3	3
N. NE																								
NE	2	1			1					1	2	1	2	1	2	2	5	4	2	1	1	2	1	
E. NE																				1	1	1	1	1
East		1	2	2	2	2	2	2	1	1	1	2	2	1	1	1		1	3	1	1	1	1	2
E. SE																1	1							
SE	1	2	1	1	1	1	1	1	2	2	2	2	3	5	5	4	3	4	2	2	2	2	1	1
S. SE									1	1	1	1	1	1	1	1	1	1	2					
South	4	4	5	5	4	3	6	6	7	8	8	8	7	7	6	5	5	4	4	4	3	3	3	3
S. SW						1																		
SW	1	1	2	2	2	3	3	1													1	1	1	
W. SW																								
West	3	1	1	2	1	1										1	1	2	1	2				2
W. NW							1	1																
NW	3	3	3	3	2	2	2	2	2											1	3	4	4	2
N. NW																								
Sums	16	16	17	17	15	15	17	16	17	18	18	18	18	17	17	17	17	17	17	16	16	16	15	14
Calms	2	2	1	1	3	3	1	2	1	0	0	0	0	1	1	1	1	1	1	2	2	2	3	4
JULY, 1865.																								
North	7	6	4	4	3	1	2	4	6	7	7	5	5	5	6	7	7	7	7	7	8	7	8	7
N. NE																								
NE					1	1	2	1	1	2	4	5	5	5	3	3	2	2	2	1		1		
E. NE						1																		
East	1	1	1	1	1	1																		
E. SE							1	1	1	1	1	1	1											
SE	1			1	1	2	2	2	1		1	2	2	3	2	1	1	1	2	2	2	2	2	1
S. SE																								
South	1	2	2	1	1				1	2	4	5	5	5	7	7	8	7	6	4	4	4	3	2
S. SW																								
SW			2	2	2	3	3	3	2	1										1	1	1	1	
W. SW																								
West	2	3	2	1	1	1	1	1	3	4	2	1	1									2	3	3
W. NW		1	3	3	2	2	2	2						1	1	1	1	1	1	1	1	1	1	1
NW	3	4	5	6	7	7	6	5	4	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1
N. NW						1	1	1	1	1														1
Sums	15	17	19	19	19	20	20	20	20	20	20	20	20	20	20	20	20	19	19	17	17	19	19	16
Calms	5	3	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	3	3	1	1	4
AUGUST, 1865.																								
North	5	6	4	2	3	4	3	4	4	5	7	8	8	9	10	9	9	7	7	6	9	9	5	5
N. NE				1	1	1	2	3	3	2	1					1	1						1	1
NE	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1				
E. NE																								
East	1	1	2	2	2	1	1			1									1	1	1	1	1	
E. SE															2	2	2	2	2	1	1	1		
SE	1	1	1	1	1	2	1	2	2	3	4	6	6	6	3	2	4	5	4	4	4	2	2	2
S.SE														1	1	1						1	1	
South	5	2	2	3	4	5	4	4	5	5	6	7	9	7	7	9	8	7	6	6	6	6	6	8
S. SW		1					1	1		1	1													
SW	2	4	4	2	2	2	3	2	1	1	1	1			1									1
W. SW									1	1		1												
West	2	3	4	4	3	2	1	3	3	1			1										1	1
W. NW	1							1	1	1	1			1										
NW	4	5	7	9	7	6	5	5	3	2	2	1	1		1	1	1	1						1
N. NW	1	1	1	1	1	1	1					1	1	1	1	1	1	2	2	2			1	1
Sums	23	25	26	26	25	25	23	26	24	24	24	26	27	26	26	27	27	25	23	21	21	20	18	20
Calms	4	2	1	1	2	2	4	1	3	3	3	1	0	1	1	0	0	2	4	6	6	7	9	7

TABLE B B.—*Showing the duration of the wind, &c.*—Continued.

Points.	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
JUNE, JULY, AND AUGUST, 1865.																								
North	14	15	11	8	8	7	7	11	14	17	18	17	16	16	18	18	17	15	17	17	21	18	16	15
N. NE	...	...	...	1	1	1	2	3	3	2	1	...	...	...	...	1	1	..	..	..	..	..	1	1
NE	3	2	1	2	3	2	3	2	2	4	7	7	8	7	5	6	8	7	5	3	1	3	1	..
E. NE	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	..	..	..	..	1	1	1	1	1
East	2	3	5	5	5	4	3	2	1	2	1	2	2	1	1	1	..	1	4	2	2	2	2	2
E. SE	...	...	...	...	...	...	1	1	1	1	1	1	1	...	2	3	3	2	2	1	1	1	..	..
SE	3	3	2	3	3	5	4	5	5	5	7	10	11	14	10	7	8	10	8	8	8	6	5	4
S. SE	...	...	...	...	...	...	...	...	1	1	1	1	1	2	2	2	1	1	2	..	..	1	1	..
South	10	8	9	9	9	8	10	10	13	15	18	20	21	19	20	21	21	18	16	14	13	13	12	13
S. SW	..	1	...	...	...	1	1	1	...	1	1	...	...	...	...	..	..	..	..	..	..	..	..	..
SW	3	5	6	6	6	8	9	6	4	2	1	1	...	...	1	..	..	..	..	1	2	2	2	1
W. SW	...	...	...	...	...	...	...	...	1	1	...	1	...	...	...	..	..	..	..	..	..	..	..	..
West	7	7	7	7	5	4	2	4	6	5	2	1	3	...	...	1	1	2	1	2	..	2	4	6
W. NW	1	1	3	3	2	2	3	4	1	1	1	...	...	2	1	1	1	1	1	1	1	1	1	1
NW	10	12	15	18	16	15	13	12	9	4	3	2	2	1	2	2	2	2	1	2	4	5	5	4
N. NW	1	1	1	1	1	2	2	1	1	1	...	1	1	1	1	1	1	2	2	2	..	..	1	2
Sums	54	58	62	62	59	60	60	62	61	62	62	64	65	63	63	64	64	61	59	54	54	55	52	52
Calms	11	7	3	3	6	5	5	3	4	3	3	1	0	2	2	1	1	4	6	11	11	10	13	1

TABLE C C.—*Showing the duration of the wind at the several points of the compass for each hour of the day, the stormy and cloudy days being eliminated for the following months:*

Points.	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
JUNE, JULY, AND AUGUST, 1861, 1862, 1863, AND 1864, AT MILWAUKEE, WIS.																								
North	5	5	7	5	2	7	7	11	13	3	2	1	...	2	1	2	3	8	3	7	5	13	10	7
N. NE	18	21	15	16	24	26	27	34	36	27	22	13	15	13	12	15	22	23	22	19	15	19	15	15
NE	7	7	3	5	4	6	21	19	19	25	22	24	23	25	23	22	20	19	13	11	11	7	2	2
E. NE	1	3	1	2	4	4	6	9	12	15	19	22	15	10	15	13	12	7	10	7	5	2	...	...
East	1	...	2	...	1	1	5	6	6	6	10	3	5	7	9	12	5	3	8	4	5	1	2	2
E. SE	3	3	2	1	1	3	2	13	21	34	31	45	51	48	48	28	31	18	8	5	5	4	5	3
SE	...	1	...	1	1	3	9	10	21	26	39	47	49	59	56	61	57	58	33	19	13	8	5	4
S. SE	6	4	4	4	4	3	2	3	4	4	8	2	4	5	8	16	10	16	13	9	10	4	7	4
South	3	..	2	3	4	3	2	4	4	3	4	2	7	5	1	4	2	3	3	7	6	4	3	2
S. SW	9	13	8	5	5	9	10	12	10	10	8	11	6	9	12	7	8	9	15	12	18	16	11	13
SW	20	16	17	15	10	9	20	15	18	26	21	22	24	19	15	19	21	14	11	11	15	20	24	24
W. SW	22	20	21	18	18	21	20	24	24	18	13	12	6	7	6	8	7	12	11	6	6	5	16	17
West	6	4	3	5	4	8	13	11	8	5	8	8	11	8	7	5	7	3	2	3	3	4	1	4
W. NW	9	14	12	12	11	11	16	18	20	13	17	15	12	11	15	15	9	6	8	5	8	3	5	8
NW	12	9	13	17	15	19	21	12	9	16	12	10	8	11	7	9	9	10	5	4	7	10	9	6
N. NW	10	8	11	9	10	10	12	14	9	7	3	3	6	2	4	2	4	3	4	5	6	4	12	10
Sums	132	129	120	119	121	144	193	204	234	236	239	240	240	241	239	238	234	212	170	135	138	123	129	124
Calms	109	112	122	118	114	85	42	25	4	3	1	1	1	1	1	3	6	25	66	101	102	118	112	117
JUNE, JULY, AND SEPTEMBER, 1862, AT CLEVELAND, OHIO.																								
North	...	2	...	...	...	...	...	...	1	3	4	5	3	3	...	...	1	2	...	...	...	...	...	...
N. NE	4	2	3	1	1	1	1	1	2	2	6	6	10	11	10	5	2	1	1	1	1	1	1	2
NE	3	1	1	1	1	...	...	1	...	1	...	1	1	4	5	9	10	6	2	...	...	...	...	2
E. NE	...	...	...	...	...	...	...	...	1	1	1	...	1	...	...	...	2	6	6	3	...	...	...	...
East	1	2	1	...	...	1	...	1	1	...	...	...	...	1	2	...	...	1	...	3	...	..	1	...
E. SE	1	1	1	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	1	2	2	...	...	...
SE	1	2	2	2	2	2	3	...	...	...	...	...	1	...	1	1	1	...	...	1	1	3	...	...
S. SE	25	27	26	24	26	26	22	16	11	6	4	4	...	1	1	3	3	4	7	8	19	25	26	29
South	...	...	1	...	...	...	2	2	3	2	1	2	2	1	1	...	...	...	...	1	1	3	2	2
S. SW	3	3	6	6	6	6	7	3	2	4	5	5	...	...	...	1	2	3	6	8	6	7	9	6
SW	...	2	1	4	3	3	3	7	6	4	3	1	6	6	7	4	5	2	2	...	3	4	3	1
W. SW	1	1	1	...	...	...	1	4	5	7	4	4	1	1	1	3	1	2	...	1	1	...	3	1
West	...	1	1	...	...	1	...	...	3	...	1	2	1	1	1	...	1	...	...	...	...	...	...	...
W. NW	3	1	2	1	1	1	2	2	2	5	6	7	9	4	4	4	3	2	2	1	2	1	1	2
NW	1	1	1	3	2	1	1	1	1	1	2	3	2	3	1	3	1	1	...	...	...	...	...	...
N. NW	3	1	...	1	2	2	1	1	1	...	2	4	9	8	6	7	6	4	2	...	...	...	...	...
Sums	46	47	47	43	44	44	43	40	39	36	39	44	46	44	40	40	38	34	29	29	36	44	46	45
Calms	10	9	9	13	12	12	13	16	17	20	17	12	10	12	16	16	18	22	27	27	20	11	9	9

TABLE C C.—*Showing the duration of the wind, &c.*—Continued.

Points.	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
JUNE, JULY, AND AUGUST, 1864 & 1865, AT THUNDER BAY ISLAND, MICH.																								
North	29	30	23	18	16	16	17	23	27	30	32	31	26	23	30	33	32	30	31	31	34	31	28	25
N. NE	...	...	...	1	1	2	2	3	3	2	1	...	...	...	...	...	1	...	...	...	...	...	1	1
NE	5	6	6	8	9	4	4	2	4	6	11	13	17	9	6	7	10	7	6	4	2	3	2	3
E. NE	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	1	1	1	1	1
East	4	4	6	7	8	8	8	7	5	8	6	9	9	8	7	6	4	4	7	5	5	6	4	3
E. SE	...	...	...	...	...	...	1	1	1	1	2	2	2	1	2	3	3	2	2	1	1	1	...	...
SE	5	4	4	4	4	7	5	8	8	11	16	21	25	29	27	23	23	25	19	16	14	3	9	9
S. SE	...	...	...	...	...	...	...	2	2	1	1	1	2	2	2	1	1	2	...	...	...	1	1	...
South	21	19	19	18	19	18	20	22	25	27	33	36	36	37	35	37	38	36	35	31	27	26	23	24
S. SW	1	2	1	...	1	2	2	1	2	2	...	...	...	...	...	1	...	1	1	...	...	1	1	1
SW	5	9	10	9	10	10	11	8	6	4	1	2	1	1	5	3	2	3	3	3	5	4	4	4
W. SW	...	...	1	...	...	1	...	...	2	1	...	1	...	...	...	...	...	...	...	...	...	1	1	1
West	18	15	16	15	11	10	10	10	12	12	8	4	4	2	1	2	2	2	1	3	2	4	10	15
W. NW	1	3	4	5	6	6	6	7	4	2	2	...	...	3	3	1	1	2	2	1	2	2	1	1
NW	20	22	28	33	34	33	31	28	22	15	9	6	6	3	5	6	6	6	4	5	8	10	10	12
N. NW	1	1	1	1	1	2	2	1	1	1	...	1	...	1	1	1	1	2	2	3	...	...	1	2
Sums	109	115	121	118	120	120	119	122	122	124	124	127	128	125	124	126	124	121	115	104	101	100	97	102
Calms	19	13	7	10	8	8	9	6	6	4	4	1	...	3	4	2	4	7	13	24	27	28	31	26
JUNE, JULY, AND AUGUST, 1864 & 1865, AT THUNDER BAY ISLAND, MICH.																								
North	29	30	23	19	17	18	19	26	30	32	33	31	26	29	30	33	33	30	31	31	34	31	29	26
NE	5	6	6	8	9	5	4	2	4	6	11	13	17	9	6	7	10	7	6	5	3	4	3	4
East	4	4	6	7	8	8	9	8	6	9	8	11	11	9	9	9	7	6	9	6	6	7	4	3
SE	5	4	4	4	4	7	5	10	10	12	17	22	27	31	29	24	24	27	19	16	14	10	10	9
South	22	21	20	18	20	20	22	23	27	29	33	36	36	37	35	38	38	37	36	31	27	27	24	25
SW	5	9	11	9	10	11	11	8	8	5	1	3	1	1	5	3	2	3	3	3	5	5	5	5
West	19	18	20	20	17	16	16	17	16	14	10	4	4	5	4	3	3	4	3	4	4	6	11	16
NW	21	23	29	34	35	35	33	29	23	16	9	7	6	4	6	7	7	8	6	8	8	10	11	14
Sums	110	115	119	119	120	120	119	123	124	123	122	127	128	125	124	124	124	122	113	104	101	101	97	102
Calms	18	13	9	9	8	8	9	5	4	5	6	1	0	3	4	4	4	6	15	24	27	28	31	26

APPENDIX D.

Return of Charts issued at Detroit and Buffalo from July 1, 1866, *to June* 30, 1867.

Charts of—	1866.						1867.						Total of each.
	July.	August.	September.	October.	November.	December.	January.	February.	March.	April.	May.	June.	
Lake Erie	25	25	12	18	10	1	....	2	6	33	44	36	212
West end of Lake Erie	18	23	16	17	7	1	....	2	5	31	41	34	195
Kelly's and Bass Islands	21	20	18	18	8	1	....	1	5	28	39	37	196
Straits of Mackinac	21	28	13	17	8	1	1	1	6	27	34	34	191
East Neebish Rapids	16	19	9	14	5	1	....	3	5	16	27	29	144
Head of Green Bay	19	26	13	19	8	1	....	1	6	21	35	23	172
St. Clair Flats	26	25	12	18	7	1	....	2	5	32	39	33	200
Buffalo Harbor	21	26	14	19	9	1	....	1	5	26	37	37	196
Tawas Harbor	24	24	13	20	8	1	....	1	5	29	37	38	200
Beaver Group	21	25	15	16	9	1	....	1	5	26	34	34	187
Eagle Harbor	14	19	9	14	5	1	....	2	5	17	29	29	144
Agate Harbor	13	19	9	14	5	1	....	2	5	16	27	29	140
St. Mary's River, No. 1	17	18	10	13	5	1	....	2	5	16	31	31	149
St. Mary's River, No. 2	17	18	10	14	5	1	....	2	5	17	30	31	150
Maumee Bay	20	28	14	20	9	1	....	3	5	28	40	31	199
Eagle River	14	19	10	17	5	1	....	2	5	17	28	29	147
Ontonagon Harbor	14	19	10	15	5	1	....	2	5	19	28	30	148
Saginaw Bay	28	24	11	20	6	1	....	2	6	36	42	37	213
Thunder Bay	25	25	15	19	10	2	1	2	6	33	36	33	207
Marquette Harbor	15	19	10	15	5	1	....	4	5	20	28	29	151
Presque Isle and Middle Island.	27	30	14	19	11	1	....	2	6	33	38	11	192
Lake Huron	30	20	11	20	12	1	1	3	5	40	37	30	210
South end of Lake Huron	19	29	23	18	13	2	....	4	6	38	41	42	235
Grand Island, L. S	17	27	14	24	9	2	....	5	5	24	35	35	197
West end of Lake Superior	18	28	18	25	9	2	1	5	5	40	36	38	225
Grand and Little Traverse Bays.	32	34	18	28	1	2	....	5	9	45	36	38	248
North end of Green Bay	16	24	23	31	15	2	....	5	11	48	42	28	245
Copper Harbor	......	......	......	9	7	2	1	5	5	44	45	38	156
L'Anse and Keweenaw Bay	......	......	......	......	1	2	1	5	5	46	45	37	142
Portage Lake	......	......	......	......	......	......	....	......	......	......	38	35	73
Total in each month	548	641	364	511	217	37	6	77	162	846	1079	976	5,464

Table showing the annual issue prior to July 1, 1867.

Charts issued—	Number.	Charts issued—	Number.
Prior to October 1, 1857	2,500	October 1, 1863, to October 1, 1864	3,283
October 1, 1857, to October 1, 1858	1,675	October 1, 1864, to October 1, 1865	2,589
October 1, 1858, to October 1, 1859	2,600	October 1, 1865, to October 1, 1866	2,082
October 1, 1859, to October 1, 1860	4,890	July 1, 1866, to July 1, 1867	5,464
October 1, 1860, to October 1, 1861	3,254	Total to July 1, 1867	37,666
October 1, 1861, to October 1, 1862	5,245		
October 1, 1862, to October 1, 1863	4,084		

APPENDIX V.

ENGINEER DEPARTMENT,
Washington, May 20, 1867.

SIR: The letter of Samuel Adams respecting his examinations of the Colorado River of the West, referred to this department for report, confirms other information in possession of this office regarding the importance of resuming the explorations of that river to its source, beginning at the locality where Lieutenant Ives, of the topographical engineers, terminated his survey, a few miles below the Mormon settlement of Callville, the present head of navigation, over 500 miles from the mouth of the river.

Between Callville and the sources of the river there are larger portions of the Colorado entirely unexplored. At two points in Great Cañon region, 100 and 150 miles, respectively, above Callville, Lieutenant Ives succeeded in getting down to the surface of the river with his land party, and considered it at these points unnavigable in the low-water stage, owing to rocks and rapids. The marks of high water were 50 feet above the low-water.

So far as known, the duration of the high water in this part of its course is brief, and the time of its occurrence uncertain.

It has been stated that during the last winter the river was ascended some 50 or 80 miles in a skiff from Callville, and found to be navigable for steamers at that time.

When Colonel Macomb in his exploration reached the vicinity of the junction of the Green and Grand rivers, the principal tributaries of the Colorado, he was unable to descend to the surface of the river, owing to the great cañons.

About midway between the junction of the Green and Grand rivers and the highest point at which Lieutenant Ives reached the river surface, Escalante in 1776 crossed the river, but only after a search of several days for a crossing place. It is probable that the Mormon crossing mentioned by Captain Adams is at this point.

It will be perceived from the foregoing statement that the Colorado river is virtually unknown between the Mormon settlement of Callville and the junction of the Green and Grand rivers, which form the Colorado, in latitude 38°, a distance of about 400 miles.

Green river, the chief branch, rising in latitude 43°, is also but little known in its length of more than 700 miles, so far as relates to its adaptation to purposes of navigation.

The lower portions of Green river run through cañons; with that exception it is a valley stream, and should be explored at a different season and in a different manner from the Colorado.

The exploration of the Colorado should be commenced from Callville during the low-water stage, early in December, and should be made in a flat-bottomed, iron stern-wheel steamer, not drawing more than 12 inches, as recommended by Lieutenant Ives.

To this should be added light skiffs enough for the whole party, so that the expedition may be continued in them beyond the highest point the steamer may be able to reach in the event of her being disabled by sunken rocks, or other accident.

The party should be commanded by an officer of engineers, and composed in the manner usual for exploring parties.

Green river, except the lower part, should be examined in the summer or fall, by a party provided with land transportation and boats, and the examinations may commence in the upper part of its course.

The only appropriation applicable to exploration and survey of the interior is that made for surveys for defence.

An examination of the Colorado simply for military purposes might be made by a small engineer party and escort at a cost of $15,000 or $20,000 to the fund for military defences, provided the quartermasters' department could furnish the transportation for the escort—that is, pay for one-half the cost of the steamer and skiffs.

The examination of the Green river should not cost more than $10,000.

In addition to these two explorations the necessity of the removal of the obstructions to the navigation of the Colorado below Callville will soon attract attention, as there seems to be a growing trade upon it, employing some seven or eight steamers.

Very respectfully, your obedient servant,

A. A. HUMPHREYS,
Brig. Gen. and Chief. Engineer, Major General Vols.

Hon. E. M. STANTON,
Secretary of War.

V 1.

ENGINEER DEPARTMENT,
Washington, March 21, 1867.

SIR: In accordance with directions of the Secretary of War of this date, you are appointed to take charge of the explorations provided for in section 3 of the act of Congress, approved March 2. 1867, authorizing the Secretary of War to direct a geological and topographical exploration of the territory between the Rocky mountains and the Sierra Nevada mountains, including the route or routes of the Pacific railroad.

The object of the exploration is to examine and describe the geological structure, geographical condition and natural resources of a belt of country extending from the 120th meridian eastward to the 105th meridian along the 40th parallel of latitude, with sufficient expansion north and south to include the lines of the "Central" and "Union Pacific" railroads, and as much more as may be consistent with accuracy and a proper progress, which should be not less than five degrees of longitude yearly. The exploration will be commenced at the 120th meridian, where it will connect with the geological survey of California, and should, if practicable, be completed in two years.

You will examine all rock formations, mountain ranges, detrital plains, mines, coal deposits, soils, minerals, ores, saline and alcaline deposits.

You will also collect material for detailed maps of the chief mining districts, coal fields, salt basins, &c., as well as material for a topographical map of the region traversed, and conduct a systematic series of barometric and thermometric observations, with constant study of the atmospheric conditions bearing upon the subject of refraction and evaporation.

You will also make collections in botany and zoology, with the view to a memoir on these subjects, illustrating the occurrence and distribution of plants and animals.

You are authorized to employ the following assistants, at the monthly rates of compensation set opposite to each respectively, namely:

One assistant geologist	$200
One assistant	150
One topographical assistant	200
One topographical assistant	150

One botanical collector	$50
One zoological collector	50
One photographer	100
Six laborers, at rates of locality.	

Your own compensation as geologist in charge of the exploration will be at the rate monthly of $250.

You are authorized to subsist the employés, including yourself while on duty in the field, as is usual in like surveys, and you are authorized by the War Department to purchase subsistence stores from the subsistence department of the army, when practicable. You are also authorized by the War Department to call upon the commanding general of the division of the Pacific to furnish an escort of twenty mounted men, (California cavalry if possible,) with the proper number of non-commissioned officers and the necessary camp equipage, subsistence and transportation therefor.

You are authorized to make the outfit for your employés, embracing camp equipage, subsistence, and transportation, to be paid from the funds applicable to the exploration.

You will make requisition upon the engineer department for funds as they may be needed for outfit, and for the current expenditures for the month succeeding. All funds expended by you must be in accordance with the rules and regulations prescribed for the disbursement of public funds, with which you will acquaint yourself before proceeding upon your exploration.

You will be required to enter into bonds for the faithful expenditure of such funds, in the amount of $20,000, with two sureties, according to the form herewith.

You will make reports monthly, or more frequently if occasion requires it, of the progress of the exploration, stating in general terms the duties upon which the employés have been engaged and the results obtained. If not within reach of the line of mail communication at the time of making up your monthly reports, you will transmit them as soon thereafter as the means at your disposal will admit, either through a messenger or other safe conveyance to the nearest mail station.

Very respectfully, your obedient servant,

A. A. HUMPHREYS,

Brig. Gen. and Chief of Engineers, Major General Vols.

Mr. CLARENCE KING, *Washington.*

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